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As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey
MS 425 National Center
Reston, VA 22092

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SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1A. Properties

NBS/NRC STEAM TABLES: THERMODYNAMIC AND TRANSPORT PROPERTIES AND COMPUTER PROGRAMS FOR VAPOR AND LIQUID STATES OF WATER IN SI UNITS,
National Bureau of Standards, Washington, DC.
L. H. Haar, J. S. Gallagher, and G. S. Kell.
Hemisphere Publishing Corporation, New York. 1984. 320 p, 14 fig, 11 tab, 70 ref, 3 append.

Descriptors: *Thermodynamics, *Steam tables, *Steam, *Physical properties, *Computer programs, *Standards, Saturation, Specific heat, Entropy, Thermal conductivity, Viscosity, Thermal properties, Surface tension, Electrical properties, Mathematical studies, Mathematical equations.

The U. S. National Bureau of Standards under the auspices of the Office of Standard Reference Data and in collaboration with the National Research Council of Canada undertook the task of correlating the large body of thermodynamic measurements for water and steam. The result of that program is a new formulation that is more accurate and has a much wider range of validity than previously existing formulations. Thermodynamic values listed in the tables were calculated from an analytic equation that is an accurate approximation to the Helmholtz function (specific Helmholtz energy) for ordinary water and steam. This book contains tables of thermodynamic property values based on this new formulation, tables of transport, and other physical property values. Tables presented include: saturation (temperature), saturation (pressure), compressed water and superheated steam, critical region, specific heat capacity at constant pressure, speed of sound, viscosity, thermal conductivity, Prandtl number, dielectric constant, and properties for coexisting phases (viscosity, thermal conductivity, Prandtl number, dielectric constant, surface tension). Appendices present information on the Helmholtz function, computer programs for thermodynamic property calculations, and equations for transport and other thermophysical properties. (Geiger-PTT)
W87-06610

2. WATER CYCLE

2A. General

RECONSTRUCTION AND ANALYSIS OF METEOROLOGICAL DATA FOR ENERGY BALANCES OVER THE VENETIAN LAGOON AND ITS HINTERLAND,
Venice Univ. (Italy). Dept. of Environmental Science.
For primary bibliographic entry see Field 2L.
W87-05974

APPLICATION OF URBAN SIMULATION MODELS TO A SMALL AND STEEP HAWAIIAN WATERSHED,
Hawaii Univ. at Manoa, Honolulu. Dept. of Civil Engineering.
Y. S. Fok, and A. Lo.
IN: Collected Reprints, Volume V: 1978-1981, June 1984. Water Resources Research Center, Honolulu, Hawaii. p 293-301, 8 fig, 2 tab, 4 ref.

Descriptors: *Small watersheds, *Simulation analysis, *Model studies, *Hydrologic models, Watersheds, Models, Runoff, Storm runoff, Kinematic wave theory, Urban runoff, Runoff rates, Rainfall-runoff relationships, Hydrographs.

Hydrological and physical characteristics of Hawaiian watersheds different from those in the continental USA provide the bases for testing the applicabilities of various urban storm simulation models. In this paper, hydrographs obtained from the ILLUDAS and St. Louis Heights Watershed models are compared with those recorded from the St. Louis Heights experimental watershed. For small storm events, both models yield similar peak discharges, but deviate a great deal from the recorded values in some cases due to the large time interval chosen for this study. Since the kinematic wave equation and field-derived standard infiltration curves are are used respectively for water routing procedures and runoff rate determination, they may account for the fact that the St. Louis Heights Watershed model is more successful in simulating peak discharges during big storm events. To further improve the St. Louis Heights Watershed model, smaller time interval (less than 5 min) data used in the numerical scheme and rainfall are needed. (See also W87-06103) (Author's abstract)
W87-06120

CRITICAL ASSESSMENT OF FORECASTING IN WATER QUALITY GOALS IN WESTERN WATER RESOURCES MANAGEMENT.
American Water Resources Association, Bethesda, MD.
For primary bibliographic entry see Field 7A.
W87-06238

LONG-RANGE STREAMFLOW FORECASTING: A STATE AGENCY PERSPECTIVE,
California State Dept. of Water Resources, Sacramento. Div. of Planning.
For primary bibliographic entry see Field 7A.
W87-06239

STATE OF THE ART IN HYDROLOGIC FORECASTING: WHAT NEXT,
D. R. Dawdy.
IN: A Critical Assessment of Forecasting in Water Quality Goals in Western Water Resources Management, Proceedings of a Symposium held in Seattle, Washington, June 11-13, 1984. 1985. p 11-14, 17 ref.

Descriptors: *Forecasting, *Hydrologic models, *Literature review, *Kalman filters, Model studies, Rainfall-runoff relationships, Streamflow.

A cursory overview of current literature has been used to try to identify those areas which indicate what is or should be the next step forward in the state of the art of hydrologic forecasting. Forecasts of the various hydrologic components contain uncertainty, but recent advances are aimed at reduction of that uncertainty. There always will remain uncertainty in any forecast, for they never will be perfect. Most attempts at the reduction of uncertainty have concentrated on improvement in the models themselves. Approaches which use updating of the state of the system or updating of forecast based on knowledge of past uncertainty have great potential. The use of updatingg methods has gained wide use, but their use should be universal. The Kalman filter, in particular, is made more useable through the development of the extended filter which estimates the components of error. Error analyses of modeling can determine where the greatest payoff can be in the development of more accurate forecasting models. The coupling of rainfall forecasts with runoff forecasts through remote sensing, particularly using radar, has great potential. The understanding of mesoscale precipitation and its development in time and space and would aid in that coupling. Finally, the problem of scale and its relation to model development for middle and large sized basins is central to the improvement of runoff forecast models. (See also W87-06238) (Lantz-PTT)
W87-06240

VALUE OF RAINFALL ESTIMATES IN RESERVOIR MANAGEMENT FOR FLOOD CONTROL,
Oklahoma Climatological Survey, Norman.
For primary bibliographic entry see Field 7B.
W87-06245

FORECASTING SEASONAL RUNOFF FOR HYDROELECTRIC OPERATIONS USING SIMULATED WATER STORAGE,
HyMet Co., Seattle, WA.
W. Tangborn, and N. Brookshier.
IN: A Critical Assessment of Forecasting in Water Quality Goals in Western Water Resources Management, Proceedings of a Symposium held in Seattle, Washington, June 11-13, 1984. 1985. p 127-132, 11 fig, 4 ref.

Descriptors: *Streamflow forecasting, *Seasonal variation, *Runoff forecasting, *Simulation analysis, *Rainfall runoff relationships, *Water storage, *Hydroelectric power, Model studies, Snowmelt, Snowpack, Statistical analysis.

A deterministic/statistical forecasting model, developed for the purpose of managing Tacoma City Light's three hydroelectric projects uses basin wtaer storage, calculated by a watershed simulation model, to forecast seasonal runoff. The simulation model first develops the snowpack, soil moisture and groundwater storage components for two altitude zones and generates daily flow sequences by the depletion of these storage reservoirs. The root-mean-square-error of daily flow simulation is used as a measure of calibration accuracy. Input to the model are daily observations of precipitation at one cooperative weather station and maximum and minimum temperatures at two stations. Forecasts of seasonal volumes beginning on January 1 and ending July 31 are produced by application of a linear regression of total water storage on the forecast day to subsequent runoff. An updating procedure is then applied by use of the observed error of a pre-forecast test season. Updating reduces the mean forecast error by an average of 25%. An evaluation of the value of forecast accuracy to increase hydroelectric generating efficiency was made by comparing historical forecast errors with the electrical energy produced per unit of stream discharge. Although several other factors influence the efficiency of generating hydro power, the economic value of accurate seasonal forecasts in producing the possible maximum energy appears to be significant. The amount of reliance that is placed on the forecast is also important in generation efficiency. The greater the certainty that the forecast is accurate within a known error range, the more precisely can the reservoir be managed. (See also W87-06238) (Author's abstract)
W87-06252

SEPARATION OF A STORM HYDROGRAPH INTO RUNOFF COMPONENTS BY BOTH FILTER SEPARATION AR METHOD AND ENVIRONMENTAL ISOTOPE TRACERS,
Tokyo Inst. of Tech. (Japan). Dept. of Civil Engineering.
M. Hino, and M. Hasebe.
Journal of Hydrology JHYDA7, Vol. 85, No. 3/4, p 251-264, July 1986. 7 fig, 12 ref.

Descriptors: *Rainfall-runoff relationships, *Tracers, *Hydrographs, *Runoff, *Isotopic tracers, *AR method, *Groundwater runoff, Overland flow, Flow, Streamflow, Tracers.

Separating the total storm runoff into runoff components of overland flow, interflow and groundwater flow is the purpose of this paper. The hourly storm hydrograph is separated into runoff components by two methods. The first method is to separate the time series of the total flow into overland flow, interflow, and groundwater flow by using numerical filters determined by the slope of the semi-logarithmic plot of the recession curve. The second method is to separate the total storm runoff, using the geochemical data, into each component by the simultaneous solution of the mass balance equations describing the fluxes of water and the tracer isotope in the stream. Both results compare relatively well with each other. (Author's abstract)
W87-06298

NON-LINEAR RUNOFF ROUTING - A COMPARISON OF SOLUTION METHODS,
Rhodes Univ., Grahamstown (South Africa). Hydrological Research Unit.
For primary bibliographic entry see Field 2E.
W87-06303

Field 2—WATER CYCLE

Group 2A—General

EL NINO AND ANNUAL FLOODS ON THE NORTH PERUVIAN LITTORAL,
Florida Univ., Gainesville. Dept. of Geography.
P. R. Waylen, and C. N. Caviedes.
Journal of Hydrology JHYDA7, Vol. 89, No. 1/2, p 141-156, December, 1986. 8 fig, 3 tab, 18 ref.

Descriptors: *Model studies, *Flood peak, *El Nino, *Flood frequency, *Peru, Gumbel distribution, Statistical models, River flows, Ocean currents, Temperature.

A three-component mixed Gumbel distribution satisfactorily models the observed annual flood frequencies of northern Peruvian rivers, which display highly variable annual peak-flood characteristics corresponding to three sets of ocean-atmosphere conditions. Physical support for the 'a priori' subdivision of the series is provided by consideration of the regional offshore oceanic-atmospheric conditions. Exceptionally warm waters (El Nino) cause extensive heavy rains; unusually cold waters (anti-El Nino) restrict both the quantity and distribution of precipitation. Model parameters reveal marked spatial trends in the severity and extent of flooding during any set of offshore conditions and geographic shifts in the regional flood-frequency characteristics between such conditions. (Author's abstract)
W87-06384

SYMPOSIUM ON TROPICAL HYDROLOGY AND 2ND CARIBBEAN ISLANDS WATER RESOURCES CONGRESS.
American Water Resources Association, Bethesda, MD.
Proceedings of the International Symposium, May 5-8, 1985, San Juan, Puerto Rico. 1985. 176 p. Edited by Ferdinand Quinones and Ana V. Sanchez.

Descriptors: *Tropical regions, *Hydrologic budget, *Hydrologic properties, *Symposium, Wind, Temperature, Humidity, Geology, Geohydrology, Drainage, Precipitation, Islands.

Investigations of tropical hydrology must include hydrologic systems smaller than the Congo and Amazons' basins. The belt of tropical regions in the world includes many smaller regions, peninsulas and islands that contribute significantly to the hydrologic balance of the world. Additionally, these smaller regions can serve as 'laboratories' where many of the processes that take place in the much larger regions can be studied, documented, and simulated. The hydrology of the tropics is affected by many factors that manifest themselves in a series of characteristics: wind patterns, temperature, humidity, insolation, physiography, geology, drainage, and precipitation are among the principal factors. The manifestations occur in the form of trade winds, monsoons, tropical storms and hurricanes, high humidity, high temperature and evapotranspiration rates, floods, landslides and erosion. The investigation of these processes involves traditional methods in hydrology as well as new techniques. The organization of this 'International Symposium on Tropical Hydrology' followed a pathway that resulted in a natural division of the sessions presented at the meeting. The session on 'General Hydrology' covers topics that bridge several of the manifestations of the hydrologic factors in the tropics. Since many islands fall within the tropical zones of the world, a significant number of papers were grouped in the 'Hydrology of Islands' session. One of the principal characteristics of the tropics is the intensity and duration of rainfall, many times as part of storms and hurricanes which result in severe floods. The session on 'Floods and Hurricanes' includes excellent examples of these characteristics. Rapid advancement in the area of simulation has resulted in the development of many modeling approaches toward hydrologic processes. These models are being applied in tropical regions in an effort to understand these systems better. A cross section of models now in use were included in the 'Modeling of Hydrologic Processes' session. (See also W87-06456 thru W87-06491) (Lantz-PTT)
W87-06455

TROPICAL DEFORESTATION AND EVAPOTRANSPIRATION,
Georgia Univ., Athens. Inst. of Ecology.
For primary bibliographic entry see Field 2D.
W87-06457

HYDROLOGIC BUDGETS FOR UNDISTURBED AND REGENERATING TROPICAL RAINFORESTS ON HILLSLOPES IN NORTHEASTERN COSTA RICA,
Georgia Univ., Athens. Inst. of Ecology.
G. G. Parker, J. C. Luvall, and C. F. Jordan.
IN: Symposium on Tropical Hydrology and 2nd Caribbean Islands Water Resources Congress, Proceedings of the International Symposium, May 5-8, 1985, San Juan, Puerto Rico. p 11-15, 2 fig, 1 tab, 3 ref.

Descriptors: *Hydrologic budget, *Tropical regions, *Costa Rica, Rain forests, Deforestation, Evapotranspiration, Model studies, Precipitation, Soil water.

Deforestation in temperate and arid regions results in increases in water yield, due to reductions in evapotranspiration. In wet tropical regions deforestation could either increase water yield (due to high annual precipitation) or scarcely affect it (due to high evaporative potential). The objective of this study is to quantify effects on the hydrologic balance of felling mature tropical rainforest on hillslopes in northeastern Costa Rica for the first thirteen months after cutting. The data are derived from a budgetary model which calculates the daily flows of various pathways of precipitation and evaporation and, at regular intervals, the percolation from the rooting zone (the top 700 mm of soil). Inputs to the budgets are incident precipitation (measured daily), evapotranspiration as estimated daily with the Penman-Monteith combination equation, soil moisture content (from observations on porous-cup tensiometers at 400 and 900 mm depth), and empirical equations for throughfall, stemflow, soil evaporation, and litter interception. The study was conducted 4.3 km SSW of the Organization for Tropical Studies' La Selva field station in Heredia province in northeastern Costa Rica. The climate is equatorial, with mean annual precipitation and temperatures of 4007 mm (+ or - 743) and 25.4 C, respectively. The felling of forest in this study involved a minimum of additional disturbance: only hand tools were used, the slash was neither moved nor burned, and excessive trampling and compaction of the soil surface were avoided. Several conclusions about the hydrologic consequences of such treatments to small areas of hillslope tropical rain forests are warranted: (a) recovery of evapotranspiration is remarkably swift: cumulative total evaporation in the regenerating forest is nearly 70% of that under the intact forest within little over a year after cutting; and (b) percolation of water below the rooting zone of the cut area increases to 52% higher than in the forest over the study period. Much of this difference is due to increases in dry season moisture retention. (See also W87-06455) (Lantz-PTT)
W87-06458

JOINT PROBABILITY APPROACH TO DESIGN HYDROLOGY IN THE TROPICS,
Army Engineer District, Jacksonville, FL.
M. L. Choate.
IN: Symposium on Tropical Hydrology and 2nd Caribbean Islands Water Resources Congress, Proceedings of the International Symposium, May 5-8, 1985, San Juan, Puerto Rico. p 32-35, 1 ref.

Descriptors: *Statistical analysis, *Hydrological regime, *Tropical regions, *Runoff forecasting, *Streamflow forecasting, *Probability distribution, *Florida, *Puerto Rico, *Virgin Islands, Model studies, Storm water, Rainfall, Discharge measurement.

The Jacksonville District of the U.S. Army Corps of Engineers is responsible for the engineering design and construction of civil works projects in peninsular Florida, Puerto Rico, and the U.S. Virgin Islands. The hydrologic investigations necessary for these projects are very much influenced by the unique problems associated with the tropics. Experience has shown that the failure of synthetic storm models to simulate frequency curves is not always a calibration or model refinement problem. Instead, the recognition that a flood peak can be the result of a combination of meteorologic, hydrologic, and topographic occurrences has led to the use of more complex models and joint probability statistics. Even though tedious to apply, the joint probability approach can be used in the tropics where the number of variables influencing design are numerous, and sometimes produce interesting results. After evaluating the entire matrix, a 100-yr rainfall with a dry antecendent moisture condition and a less critical rainfall distribution produces a 16-yr return period; whereas a 10-yr rainfall with average antecendent moisture and a critical rainfall distribution will produce a 17-yr event. Thus, two discharges of approximately equal magnitude were produced by two very different rainfall depths. Using joint probabilities and solving the complete matrix, the hydrologist can evaluate the impact of variables on the frequency of the events and produce more representative design conditions. (See also W87-06455) (Lantz-PTT)
W87-06462

RESPONSE OF AQUIFER TO MONSOON RAINFALL IN CENTRAL JAVA, INDONESIA,
Binnie and Partners, Lima (Peru).
S. Puri.
IN: Symposium on Tropical Hydrology and 2nd Caribbean Islands Water Resources Congress, Proceedings of the International Symposium, May 5-8, San Juan, Puerto Rico. 1985. p 41-45, 4 fig, 2 tab, 1 ref.

Descriptors: *Monsoons, *Aquifers, *Java, *Indonesia, *Groundwater recharge, *Rainfall-runoff relationships, Groundwater level, Seasonal variation.

The climate of Java is humid tropic and the main livelihood of the population is growing rice. In the wet season there are adequate water resources but in the dry season, in the absence of an irrigation scheme, rice cannot be grown in some areas, thus limiting the earnings of farmers. This paper refers to an area with no surface water resources where a study of the groundwater potential was carried out. The west monsoons bring much of the rain and G. Muria (1500 m) has a strong orographic influence. There is negligible rainfall from June to September. Recharge from monsoon rains enters the Muria Tuffs at their outcrop in the intermediate slopes. Here the aquifer is chemically well flushed because a quantity of the annual recharge drains to the river Gelis. Monitoring in numerous dug wells shows that monsoon rainfall rapidly elevates depressed groundwater levels. Toward November water levels rise rapidly to within 1-m of the ground surface. From December through to March, sustained rainfall maintains elevated groundwater levels. During the dry season there is a gradual recession due to natural outflow through streams and some pumpage. These data indicate that in monsoon conditions, the aquifer rejects further potential recharge for periods of up to 2 1/2 months. (See also W87-06455) (Lantz-PTT)
W87-06464

HYDROLOGICAL DESIGN IN PRESENCE OF LIMITED DATA,
For primary bibliographic entry see Field 7A.
W87-06470

INFLUENCE OF TROPICAL STORMS ON RUNOFF-PRODUCING RAINFALL IN THE SOUTHWESTERN UNITED STATES,
Agricultural Research Service, Tucson, AZ.
For primary bibliographic entry see Field 2B.
W87-06472

FLOODS OF APRIL 18, 1983 ON ST. THOMAS AND ST. JOHN, U.S. VIRGIN ISLANDS,
For primary bibliographic entry see Field 2E.
W87-06474

HYDROLOGIC SOLUTION FOR URBAN FLOODING IN TERESINA, BRAZIL,
For primary bibliographic entry see Field 4A.
W87-06478

FLASH-FLOOD PREDICTION SYSTEM,
National Weather Service, Silver Spring, MD. Hydrologic Research Lab.
For primary bibliographic entry see Field 2E.
W87-06480

COMPARISON OF HYDROLOGY MODELS IN A TROPICAL ISLAND,
Army Engineer District, Jacksonville, FL.
E. M. Colon.
IN: Symposium on Tropical Hydrology and 2nd Caribbean Islands Water Resources Congress, Proceedings of the International Symposium, May 5-8, 1985, San Juan, Puerto Rico. p 135-138, 2 tab, 4 ref.

Descriptors: *Rainfall-runoff relationships, *Hydrologic models, *Tropical regions, *Puerto Rico, *Rio Cibuco, *Rio Fajardo, *Rio Puerto Nuevo, Watersheds, Model studies, Mathematical models, Flow rates, Flood control, Flooding.

Various hydrologic models have been applied to watersheds in Puerto Rico to predict historic, future and synthetic responses to rainfall and simulate resultant runoff hydrographs and peak discharge rates. Although all basins on the island can be classified as small watersheds, discussion is limited to three small streams: Rio Cibuco, Rio Fajardo and Rio Puerto Nuevo. These watersheds represent basins with various degrees of development. The Rio Cibuco represents an uphill basin, primarily with a rural land use and a small town development. Rio Fajardo represents a basin partially protected by a forest preserve (the Caribbean National Forest) in its upper reaches and rural and urban development in its middle and lower reaches. Rio Puerto Nuevo is a highly developed urban watershed with portions of its upper reaches under rural type development. Mathematical models were developed for the three watersheds using the HEC-1 Flood Hydrograph Package and Technical Release 20. Applications were made utilizing the Snyder's and Soil Conservation Service's unit hydrograph methods based on curve numbers to transform rainfall excess to flow rates utilizing observed rainfall patterns and time distributions as well as depth-duration relationships for the island. Under current conditions, the estimated 100-year flood water depth at a point within the lower portions of the Rio Puerto Nuevo floodplain is about 4.2-m, while under the 1985 conditions previously stated, this level would increase to 4.3 m. The estimated water depth for the year 2035 conditions is 4.8 m. These numbers reflect an increased development and channel modification in the upstream reaches of the watershed. This will also have an impact on the size and cost of any required channel improvement to resolve the acute flooding problems within a particular watershed with protective works which have not considered runoff resultant from changes in land use. (See also W87-06455) (Lantz-PTT)
W87-06483

MODELING VIRGIN ISLANDS FLOOD HYDROLOGY USING HYMO,
CH2M Hill, Inc., Gainesville, FL.
For primary bibliographic entry see Field 2E.
W87-06484

RAINFALL-RUNOFF RELATIONSHIP IN MOANALUA VALLEY, OAHU, HAWAII,
P. J. Shade.
IN: Symposium on Tropical Hydrology and 2nd Caribbean Islands Water Resources Congress, Proceedings of the International Symposium, May 5-8, 1985, San Juan, Puerto Rico. p 146-149, 4 fig, 2 tab, 4 ref.

Descriptors: *Rainfall-runoff relationships, *Oahu, *Moanalua Valley, *Peak flow, *Routing, *Model studies, Simulation analysis, Hydrologic models, Rainfall, Flow profiles, Hydrographs.

The rainfall-runoff relationship in Moanalua Valley, an undeveloped basin on the island of Oahu, Hawaii, was modeled using the first version of the DR3M, a distributed routing, parametric model developed by the U.S. Geological Survey. Although designed for urban conditions, this model accurately simulated runoff from a wide range of storms for this rural subtropical watershed. The model was verified using rainfall data recorded at 15-minute intervals. Large floods (storm 5 was a 50-year flood) and smaller events have been fairly accurately simulated, and the model is calibrated for the basin. Although the differences between observed and simulated runoff volumes and peak flows are within acceptable limits, there are several explanations for the errors. Distributing point rainfall homogeneously over an area is a major source of error when considering the limited dimensions of storm cells that develop over Oahu. The parameter in the kinematic wave equation is held constant although wave velocity and mean water depth vary during storms. This introduces timing errors in the simulated hydrographs. The kimematic-wave method may be near its limit of applicability in modeling the steep headwaters of the basin where the calculated Froude numbers are slightly greater than 2. Basin segmentation is an oversimplification of the basin's physical structure and the problem is compounded during flow routing in that only the combined behavior of the basin's runoff processes is represented. Analysis of the modeled storms indicates that the average runoff-rainfall ratio is about 35%. For events with wet antecedent conditions, high rainfall intensities, or large rainfall totals the ratio increases to as high as 66%. This study establishes the utility of the DR3M in modeling the rainfall-runoff relationship in undeveloped watersheds. (See also W87-06455) (Lantz-PTT)
W87-06485

TIME-SERIES ANALYSIS FOR A SEMI-ARID REGION USING THE THEORY OF RUNS,
Universidade Federal da Paraiba, Joao Pessoa (Brazil).
U. Koch, and P. R. G. Serrano de Andrade.
IN: Symposium on Tropical Hydrology and 2nd Caribbean Islands Water Resources Congress, Proceedings of the International Symposium, May 5-8, 1985, San Juan, Puerto Rico. p 154-157, 10 ref.

Descriptors: *Time-series analysis, *Semiarid climates, *Theory of runs, *Drought, *Brazil, Hydrologic properties, Precipitation rate, Rainfall intensity.

The northeastern region of Brazil is periodically affected by severe droughts. Hydrologists have been requested to provide answers to questions concerning the characteristics of time-series and the probabilities in confronting precipitation deficiencies below a specific level. Although long-time series of precipitation for the region are available, the reliability in the accuracy of the results for the conventional frequency analysis is low. An attempt was made to apply the Theory of Runs, to obtain more satisfactory results. Long-term records from five representative stations located in the heart of the so-called 'Polygon of Drought' in Paraiba State, northeast of Brazil, have been studied, using various truncation levels to characterize droughts and to define probabilities simultaneously. The results demonstrate that the application of the Theory of Runs provides satisfactory information, needed by the regional planners. (See also W87-06455) (Author's abstract)
W87-06487

FILLING IN OF MISSING RAINFALL OR FLOW RECORDS IN MONSOONIC CLIMATE,
United Nations, New Delhi (India). Dept. of Technical Co-operation for Development.
A. Filotti, Y. D. Pendse, and A. S. Dhingra.
IN: Symposium on Tropical Hydrology and 2nd Caribbean Islands Water Resources Congress, Proceedings of the International Symposium, May 5-8, 1985, San Juan, Puerto Rico. p 165-168, 1 fig, 1 tab, 4 ref.

Descriptors: *Rainfall-runoff relationships, *Flow measurement, *Monsoons, *India, *Hydrologic models, Rainfall intensity, Model studies, Data interpretation.

Many of the methods applied for the study of water resources systems use, as input data, continuous time series of river flows in various cross-sections of the river basin. As such time series of flows are rarely available of the length required for an acceptable precision of water management computations, flow time series are extended, either by regression analysis or by conceptual models, using rainfall records available from a much longer period. However, even in the longer rainfall series gaps might exist; those gaps have to be filled to permit the generation of continuous time series of flows. The procedure to be used for this filling in of missing rainfall data in the specific conditions of monsoonic climate, were investigated under the U.N.D.P. assisted Project on Systems Engineering for Integrated Development of Water Resources in India. The methodology was applied experimentally on one of the major river basins in South Central India. Five models for filling in were tried on rainfalls and flows. None of the models was suitable for ten day periods. Therefore, monthly data of rainfalls were processed and filled in. These data were converted into monthly floods and thereafter for the monsoon period, these were disaggregated into ten daily flows. The models used for filling in were: (i) Weighted Average Model, (ii) Modified Weighted Average Model, (iii) FILLIN-I Model of Texas Department of Water Resources (TDWR), (iv) HEC-4 Model of U.S. Army Corps of Engineers and (v) MOSS-III Model of TDWR. The distribution of tropical rainfalls is closer to the log normal than the log-Pearson III distribution. Therefore simple models for filling in gave better results as compared to the more sophisticated procedures. The procedure recommended for further use was the FILLIN-I model of the TWRD. The models for filling in missing rainfall data can be best used for monthly values. If data for shorter time intervals is required, the preferable procedure is first to fill in the missing monthly values and thereafter to disaggregate them. Rainfalls during monsoon and dry periods were part of a simple statistical population and can be filled in by a simple procedure. (See also W87-06455) (Lantz-PTT)
W87-06489

2B. Precipitation

MODELLING COHESIVE SEDIMENT TRANSPORT IN ESTUARIAL WATERS,
For primary bibliographic entry see Field 2J.
W87-05980

DIURNAL RAINFALL VARIABILITY OVER THE HAWAIIAN ISLANDS,
Hawaii Univ., Honolulu.
T. A. Schroeder, B. J. Kilonsky, and C. S. Ramage.
IN: Collected Reprints, Volume V: 1978-1981, June 1984. Water Resources Research Center, Honolulu, Hawaii. p 12-17, 5 fig, 1 tab, 12 ref.

Descriptors: *Diurnal distribution, *Rainfall distribution, *Hawaii, *Convection, Rainfall, Islands, Precipitation, Models, Rainfall intensity, Statistical analysis, Statistical methods, Satellite technology, Wind.

Diurnal rainfall distributions were assembled for 103 Hawaiian stations and were used to examine variations of diurnal rainfall on individual islands and interisland differences. Data were partitioned by heavy and light rain days and statistical properties of diurnal variations were studied by harmonic analyses and simplified ratios of extreme frequencies. Diurnal rainfall patterns in Hawaii are produced by diurnal patterns in the tradewind layer and by intense heating and cooling. Except for a few extremely leeward stations, the diurnal rainfall pattern is the same for light and heavy rains. Local effects are a function of island size and elevation. The convective afternoon maxima on large islands are not too large or are located outside the strong tradewind belt. On smaller islands, the dominant diurnal pattern displays early morning maximum

rainfall frequency which was attributed to radiative destabilization at cloud top. These findings may be applied to observational studies of island circulations as well as numerical model simulations of three dimensional mesoscale processes. (See also W87-06103) (Geiger-PTT)
W87-06104

DIRECT INTERCEPTION OF CLOUD AND FOG WATER,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 3B.
W87-06110

QUANTITATIVE INDEX OF THE ION BALANCE FOR PRECIPITATION CHEMISTRY,
Institute of Public Health, Tokyo (Japan). Dept. of Public Health Practice.
H. Hara, K. Sekigichi, and A. Ujiie.
Environmental Technology Letters ETLEDB, Vol. 7, No. 11, p 597-600, November 1986. 5 fig, 15 ref.

Descriptors: *Chemistry of precipitation, *Precipitation, *Acid rain, *Ion balance, *Mathematical equations, Index, Japan, Weather data collections, Ions.

An index is proposed for a quality assurance for ionic species content data of precipitation samples: h=(A-C)/C for C > or = A and (A-C)/A for C < A, where C and A are, respectively, the cation and anion sum in equivalent concentration. This index was shown to describe the ion balance both quantitatively and qualitatively. Results are discussed of the application of index h to a set of 137 observations from Gumma (Japan). (Rochester-PTT)
W87-06373

STUDY OF EVAPORATION FROM TROPICAL RAIN FOREST - WEST JAVA,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2D.
W87-06375

SNOW LEVELS AND AMOUNTS IN THE MOUNTAINS OF SOUTHERN CALIFORNIA,
California Univ., Riverside.
For primary bibliographic entry see Field 2C.
W87-06377

STOCHASTIC MODEL OF RAINFALL INTERCEPTION,
Institute of Hydrology, Wallingford (England).
I. R. Calder.
Journal of Hydrology JHYDA7, Vol. 89, No. 1/2, p 65-71, December, 1986. 3 fig, 4 ref.

Descriptors: *Model studies, *Statistical models, *Interception loss, *Canopy storage, Poisson distribution, Raindrops, Probability, Prediction.

A stochastic model of rainfall interception is proposed that relates, via the Poisson probability distribution, mean number of raindrops retained on elemental surface areas to the mean number of raindrop strikes per element. The model provides a rational explanation of the observation that canopies wet up in a gradual, asymptotic manner. For the special case in which the maximum number of drops retained per surface element is less than or equal to unity, it is shown that the model takes an identical form to the exponential wetting relationship proposed by Aston. The model takes into account mean raindrop volume as an explicit input variable, and predicts that, for the same total amounts of rainfall, maximum canopy storage will be attained less rapidly for raindrops of larger volume. (Author's abstract)
W87-06379

EL NINO AND ANNUAL FLOODS ON THE NORTH PERUVIAN LITTORAL,
Florida Univ., Gainesville. Dept. of Geography.
For primary bibliographic entry see Field 2A.
W87-06384

TRACE ELEMENTS IN PRECIPITATION OVER AN INDUSTRIAL AREA OF BOMBAY,
Bhabha Atomic Research Centre, Bombay (India). Air Monitoring Section.
For primary bibliographic entry see Field 5B.
W87-06396

HOURLY RAINFALLS ASSOCIATED WITH TROPICAL STORMS AND HURRICANES NEAR THE UPPER TEXAS GULF COAST,
Houston Univ., TX. Dept. of Civil Engineering.
J. R. Rogers, and J. Grounds.
IN: Symposium on Tropical Hydrology and 2nd Caribbean Islands Water Resources Congress, Proceedings of the International Symposium, May 5-8, 1985, San Juan, Puerto Rico. p 79-82, 2 fig, 2 ref.

Descriptors: *Rainfall, *Tropical storms, *Hurricanes, *Texas, Gulf of Mexico, Rainfall intensity, Rain gages, Rainstorms.

Harris County is a flat, coastal region near the Gulf of Mexico and contains the urban development around Houston, Texas. This region is noted for high intensity rainfalls from weather fronts, tropical storms, and hurricanes. Hurricane Carla in 1961 was an intense storm to strike the Houston area. Tropical Storm Claudette in July, 1979 produced the record 24-hours U.S. rainfall near Alvin, Texas. Hourly rainfalls for these storms and others are analyzed. Data from a hurricane in August 1945 indicate that the rainfalls for several Houston area gages exhibited very similar characteristics with a second rainfall peak lagging 11-hours behind the most intense rainfall from the hurricane. (See also W87-06455) (Lantz-PTT)
W87-06471

INFLUENCE OF TROPICAL STORMS ON RUNOFF-PRODUCING RAINFALL IN THE SOUTHWESTERN UNITED STATES,
Agricultural Research Service, Tucson, AZ.
H. B. Osborn.
IN: Symposium on Tropical Hydrology and 2nd Caribbean Islands Water Resources Congress, Proceedings of the International Symposium, May 5-8, 1985, San Juan, Puerto Rico. p 83-86, 1 fig, 10 ref.

Descriptors: *Tropical storms, *Arizona, *Rainfall-runoff relationships, Seasonal variation, Thunderstorms, Orographic precipitation, Watersheds.

Moist tropical air can flow into southern Arizona at any time during the year, but is concentrated in the summer 'monsoon' season, from July through early September. The summer rainy season is characterized by widely-spaced late afternoon and early evening thunderstorm rains of high intensity, short duration, and limited areal extent. The thunderstorms may develop and dissipate individually, or propagate along lines over a period of several hours. The flow of moist air may be interrupted at any time during the rainy season by a drying period, which introduces an added uncertainty into predicting summer thunderstorm rains. The magnitude, density, areal extent and duration of thunderstorm rainfall are determined by available moisture, orographic and convective lifting, and atmospheric conditions. The available moisture depends upon the strength and duration of the flow of moist tropical air into the region. Normally, thunderstorms are too widely spaced to cause flooding on other than very small watersheds (200 sq mi and less). However, on occasion, a tropical storm (or hurricane) will push massive amounts of moist tropical air into the Southwest, causing major regional and statewide flooding. (See also W87-06455) (Lantz-PTT)
W87-06472

PROPOSED RAINFALL CLASSIFICATION SYSTEM,
National Weather Service, Silver Spring, MD. Office of Meteorology.
J. D. Belville, and G. K. Grice.
IN: Symposium on Tropical Hydrology and 2nd Caribbean Islands Water Resources Congress, Proceedings of the International Symposium, May 5-8, 1985, San Juan, Puerto Rico. p 87-89, 1 tab.

Descriptors: *Rainfall, *Classification, *Rainfall classification, *Runoff forecasting, *Flood forecasting, Hurricanes, Tornadoes, Floods, Precipitation, Rainfall intensity.

Classifying meteorological events is not a new concept. Over the past two decades, systems for classifying both tornadoes and hurricanes have been developed and are currently being widely used. Even though floods and flash floods cause more deaths and destruction annually than either tornadoes or hurricanes, a system for classifying rainfall event does not exist. One of the major problems in developing forecast techniques for heavy rainfall events is that no methods for grouping or comparing events exist. A classification scheme would solve this problem. When developing any type of system such as the one proposed, objectives which the system should meet must be set. The objectives of the proposed rainfall classification are as follows: (1) must describe the event in quantitative terms as completely as possible; (2) must be flexible, i.e., must describe all types of rainfall events; (3) should be able to relate the rainfall event to the subsequent flood event; (4) should be rather easy to apply; and (5) should be related to the meteorology of the event. The proposed rainfall classification system is very flexible and can be adapted to any type of rainfall or snowfall event. It is envisioned that the system will enable forecasters and research meteorologists alike to answer many of the questions which remain concerning heavy rainfall events. (See also W87-06455) (Lantz-PTT)
W87-06473

RAINFALL EXTREMES IN CENTRAL AND SOUTHERN FLORIDA,
S. S. T. Lin, and T. K. MacVicar.
IN: Symposium on Tropical Hydrology and 2nd Caribbean Islands Water Resources Congress, Proceedings of the International Symposium, May 5-8, 1985, San Juan, Puerto Rico. p 96-99, 2 fig, 12 ref.

Descriptors: *Rainfall, *Florida, *Lake Okeechobee, *Seasonal variations, Tropical storms, Weather patterns, Rainfall intensity, Rainfall impact, Hurricanes.

Wet and dry weather cycles are the norm in the State of Florida. Some significant deviations from average conditions have been recorded since 1979. The water level in Lake Okeechobee dropped from 17.5 ft msl in January 1980, to a record low of 9.75 ft msl on July 29, 1981 due to an extensive period of extremely low rainfall. The passage of tropical storm Dennis during August 16-18, 1981 turned the severe drought in south Florida into a severe flood situation. A maximum rainfall, up to 25.16 inches, was recorded in a 20 mile by 40 mile strip. With heavy rains following in September, a record two month rainfall totaling 48.88 inches was recorded. A large portion of southwest Dade County was flooded for up to two months. In contrast to Dennis, hurricane David, 1979, and the latest tropical storm, Isidore, 1984, produced little rain. Historically, several rainstorms which have caused flooding, damage to agriculture, and beach erosion have been recorded. Recently, the rainstorms of April 24-25, 1979 and November 21-26, 1984 have been the most severe. These events have provided valuable information on the evaluation of system performance, operational improvements, and future planning. (See also W87-06455) (Author's abstract)
W87-06475

SPATIAL AND TEMPORAL STORM RAINFALL CHARACTERISTICS IN PUERTO RICO,
Puerto Rico Univ., Mayaguez. Dept. of Civil Engineering.
I. Pagan-Trinidad, and W. S. Araya.
IN: Symposium on Tropical Hydrology and 2nd Caribbean Islands Water Resources Congress, Proceedings of the International Symposium, May 5-8, 1985, San Juan, Puerto Rico. p 158-161, 2 fig, 7 ref, append.

Descriptors: *Rainfall, *Spatial distribution, *Temporal distribution, *Puerto Rico, Model studies, Simulation analysis, Design storms, Hydrologic models, Rainfall intensity.

Analysis, modeling, simulation, and design in basin hydrology and hydraulics are sensitive to spatial and temporal storm rainfall characteristics. Safety, risk and economic analyses depend on accurate estimation of rainfall variabilities. Flood and weather forecasting are dependent on the accuracy of modeling the climate and rainfall-runoff dynamics. Weather modification such as those produced by urban development, industrial activities, air flight traffic, and induced rainfall activities can be evaluated by determining variations in storm rainfall distributions. Optimum management of water resources for small communities is sensitive to rainstorm occurrence. Reservoir operation, water quality management, and even groundwater recharge depend on the intensity, location, distribution, and frequency of storm events. The work discussed here covers a comprehensive effort guided to evaluate hourly rainfall data collected by the National Weather Service Office in Puerto Rico with the purpose of describing statistical characteristics of tropical rainstorms. Twenty-two stations with hourly rainfall records were analyzed. Record length varied from a minimum of 117 to a maximum of 204 months. The following specific conclusions can be drawn from the study: (1) Extreme storm rainfall events were selected objectively and their statistical properties were defined; (2) Storm rainfall in Puerto Rico shows temporal distribution tendencies which depend on the location, storm duration, and storm class (meaning media, tercile, or quartile storms); (3) There exist preferred periods within the storm when the most intense rainfall occurs (e.g., 1st media for 2-hour storms); (4) Spatial variabilities of temporal storm rainfall distributions are significantly larger as the storm duration increases; (5) The probability of mean storm intensities and storm durations decay with an increase of each variable accordingly. The two parameter Gamma and one parameter exponential probability density functions fitted, fairly represent probabilities of rainstorm intensities and durations throughout the island; (6) Storm selection criteria does affect the probability of mean storm intensities, storm durations, and probability distribution; and (7) Continuous rainy periods in Puerto Rico seldom last for more than twelve hours. (See also W87-06455) (Lantz-PTT)
W87-06488

FILLING IN OF MISSING RAINFALL OR FLOW RECORDS IN MONSOONIC CLIMATE,
United Nations, New Delhi (India). Dept. of Technical Co-operation for Development.
For primary bibliographic entry see Field 2A.
W87-06489

BMRC AUSTRALIAN MONSOON EXPERIMENT: AMEX,
Bureau of Meteorology, Melbourne (Australia).
G. J. Holland, J. L. McBride, R. K. Smith, D. Jasper, and T. D. Keenan.
Bulletin of the American Meteorological Society BAMIAT, Vol. 67, No. 12, p 1466-1472, December 1986. 5 fig, 32 ref.

Descriptors: *Australian Monsoon Experiment, *AMEX, *Monsoons, *Tropical regions, *Weather data collections, Weather, Data collections, Cloud physics, Weather patterns, Storms, Radar, Clouds, Australia, Radiosondes.

The BMRC Australian Monsoon Experiment (AMEX) is part of a concerted tropical research program aimed at improving the understanding of the physics and dynamics of tropical weather systems. It is based on the collection of high-density tropical upper-air soundings and radar data during two observational phases in October 1986 and January/February 1987. Phase I of the experiment is directed towards an improved understanding of the north Australian cloud lines which constitute a significant forecast problem for meteorologists, especially during the transition season and breaks in the summer monsoon. The AMEX phase I data will provide the first quantitative information on their genesis, evolution, and movement mechanisms. Phase II of AMEX will provide the only comprehensive data set on the same time and space scale as the major weather systems that exist during the Australian summer monsoon season. When combined with data from the higher-latitude sounding network over southern Australia and high-resolution aircraft data, this data set should have a major impact on the understanding of tropical weather processes. The radiosonde and radar network was designed specifically to examine the interactions that occur between convective and larger scales and to provide information on the wet-season version of the north Australian cloud lines. The objectives, backround, and rationale for the AMEX program were described in detail together with an overview of the design and timetable of the observing component. (Wood-PTT)
W87-06553

AIRBORNE CLOUD-PHYSICS PROJECTS FROM 1974 THROUGH 1984,
Naval Research Lab., Washington, DC.
R. K. Jeck.
Bulletin of the American Meteorological Society BAMIAT, Vol. 67, No. 12, p 1473-1477, December 1986. 4 tab, 1 ref.

Descriptors: *Clouds, *Cloud physics, *Reviews, *Snow, *Ice, *Cloud liquid water, *Documentation, *Publications, *Information retrieval, *Weather data collections, Data collections, Weather, Aircraft, United States, Canada, Hydrometeors.

Most of the principal airborne cloud-physics projects during the ten-year period 1974-1984 are documented to provide selected information on the type and quantity of microphysical data that were collected. The emphasis is on measurements above the melting level where over 2100 flights from 55 different projects took place. Most (1825) flights are from the United Sates and Canada, but 319 are from various locations around the world. The number of flights with data on liquid-water content, droplet sizes, ice particles, snow, and other hydrometeors are tabulated. (Author's abstract)
W87-06554

INLAND SPRUCE CONE RUST (CHRYSOMYXA PIROLATA) CONTROL: RELATION OF FERBAM APPLICATION TO BASIDIOSPORE PRODUCTION, RAINFALL, AND CONE PHENOLOGY,
British Columbia Ministry of Forests, Victoria. Silviculture Branch.
For primary bibliographic entry see Field 2I.
W87-06604

2C. Snow, Ice, and Frost

FORMATION OF SOIL FROST AS INFLUENCED BY TILLAGE AND RESIDUE MANAGEMENT,
Agricultural Research Service, Pendleton, OR. Columbia Plateau Conservation Research Center.
J. L. Pikul, J. F. Zuzel, and R. N. Greenwalt.
Journal of Soil and Water Conservation JSWCA3, Vol. 41, No. 3, 196-199, May-June 1986. 7 fig, 16 ref.

Descriptors: *Frost protection, *Thawing, *Soil frost, *Tillage, *Crop residue management, *Frozen soil, Soil erosion, Columbia Basin, Oregon, Washington, Snow cover, Standing stubble, Fall-plow, Fall-chisel, Straw mulch, Heat flux, Cyclonic storms, Rain.

Frozen soil is a major factor contributing to high soil erosion in the Columbia Basin and Plateau of Oregon and Washington. The coldest winter temperatures often occur when the ground is bare of snow. In the absence of snow cover, crop residue on the surface can provide thermal insulation of the soil and reduce the incidence and severity of soil frost. Soil frost was measured during four winters in northeastern Oregon. Residue and tillage treatments included standing stubble, fall-plow, fall-chisel, straw mulch, bare surface and winter wheat. Standing stubble consistently reduced the depth of frost penetration by an average of 35% compared to the bare surface. There was little difference in frost penetration between fall-plowed or chiseled stubble. Heat flux in the bare surface treatment was 40% greater than in the standing stubble treatment when clear skies and warm air temperatures characterized the thawing weather. Bare and stubble treatments thawed the same day even though the bare treatment was frozen to a deeper depth. In contrast, the standing stubble treatment thawed four days earlier than the bare surface treatment when the thawing weather was characterized by low air temperatures and overcast skies. These conditions are associated with the advance of moisture-laden cyclonic storms that can cause rainfall and subsequent erosion on the thawing soil. (Author's abstract)
W87-05968

AERIAL SURVEY OF A SALT MARSH: ICE RAFTING TO THE LOWER INTERTIDAL ZONE,
New Hampshire Univ., Durham. Jackson Estuarine Lab.
For primary bibliographic entry see Field 2L.
W87-05972

CALCITE DEPOSITION FROM CARBONACEOUS PARTICLES SCAVENGED BY SNOW,
Bologna Univ. (Italy). Ist. di Geologia.
For primary bibliographic entry see Field 5B.
W87-05975

VARIATION IN PRECIPITATION QUALITY DURING A 40-HOUR SNOWSTORM IN AN URBAN ENVIRONMENT--DENVER, COLORADO,
Geological Survey, Arvada, CO.
L. J. Schroder, and A. G. Hedley.
International Journal of Environmental Studies IJEVAW, Vol. 28, No. 2/3, p 131-138, 1986. 3 fig, 3 tab, 9 ref.

Descriptors: *Precipitation, *Water quality, *Snow, *Storms, *Temporal distribution, *Pollutant identification, *Acid rain, *Water pollution services, *Denver, Colorado, *Urban areas, *Chemistry of precipitation, Distribution, Heavy metals, Barium, Calcium, Cadmium, Chlorides, Iron, Potassium, Sodium, Nitrates, Phosphates, Sulfates, Copper, Zinc, Hydrogen ion concentration, Acidity.

Seventeen precipitation samples were collected during a 40-hour snowstorm in the northwestern part of the Denver, Colorado metropolitan area. Maximum concentrations of barium, calcium, cadmium, chloride, iron, potassium, magnesium, sodium, nitrate, phosphate, and sulfate occurred during the initial three hours of the storm. Maximum copper concentrations occurred nearly six hours after the storm began, maximum strontium concentration occurred 25 hours after the storm began, and maximum zinc concentration occurred 12 hours after the storm began. Concentrations of beryllium, cobalt, lithium, and vanadium were less than the analytical detection limits during the entire storm. The lowest pH value was determined in samples collected during or immediately after normal peak automobile traffic, occurring nearly 14 hours after the storm began. (Author's abstract)
W87-05996

TIME-SERIES APPROACH TO MODELLING STREAM ACIDITY,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 7C.
W87-06300

SNOW LEVELS AND AMOUNTS IN THE MOUNTAINS OF SOUTHERN CALIFORNIA,
California Univ., Riverside.
R. A. Minnich.
Journal of Hydrology JHYDA7, Vol. 89, No. 1/2, p 37-58, December, 1986. 10 fig, 3 tab, 32 ref.

Descriptors: *Snow depth, *California, *Snow surveys, *Snowline, *Precipitation, *Radiosonde analysis, San Bernardino Mountains, Atmospheric physics, Freezing lines, Elevation, Jet stream, Storms, Temperature.

Using data from the San Bernardino Mountains, 100 km east of Los Angeles, California, long-term snowfall to annual precipitation ratios were generated by correlating radiosonde storm freezing levels recorded at San Diego with hourly precipitation at Big Bear Dam. Liquid equivalent of snowfall was developed by graphical analysis of snow profiles against high resolution precipitation data, and contour data. Radiosonde analysis also permitted physical interpretation of atmospheric thermal structure and dynamic processes central to the generation of precipitation and vertical distribution of snowlines. The long-term mean snowline is 2300 m; nearly all precipitation is snow above 3000 m; and snow is unusual below 1250 m. Storm freezing lines decline through precipitation season owing to cooling of ocean waters and the West Coast marine layer. Peak snow accumulation rates occur in winter at highest altitudes, but skews toward spring at intermediate altitudes. Interannual fluctuations in snowlines result from numerous factors, including stochastic variability of storms owing to southern California's marginal position to the jet stream, coupling of air mass temperatures to precipitation intensities, seasonal distribution of storms, and latitudinal displacement of the jet stream. Higher precipitation rates coincide with higher snowlines at all time scales, resulting in an inverse trend between total precipitation and areal snow cover. (Author's abstract)
W87-06377

HYDROLOGY OF A WETLAND IN THE CONTINUOUS PERMAFROST REGION,
McMaster Univ., Hamilton (Ontario). Dept. of Geography.
N. T. Roulet, and M.-K. Woo.
Journal of Hydrology JHYDA7, Vol. 89, No. 1/2, p 73-91, December, 1986. 9 fig, 2 tab, 29 ref.

Descriptors: *Wetlands, *Hydrology, *Permafrost, *Hydrologic budget, Canada, Northwest Territories, Baker Lake, Streamflow regulation, Snowmelt, Rainfall, Evaporation.

The hydrologic system was examined in a wetland 80 km west of Baker Lake, Northwest Territories (Canada), which is the region of continuous permafrost. Water balance computation quantified the relative importance of various hydrogeological processes, including snowmelt, rainfall, inflows, evaporation, and surface and subsurface outflows. The existence of this wetland is closely related to a lake upslope, which provides the bulk of the water input. The ability of northern wetlands to absorb input water is limited by the frozen ground and the high specific retention of the peat, rendering the wetland a poor regulator of streamflow. Storage capacity increases in summer as evaporation reduces the moisture content of the peat. Subsurface flow remains significant because of the low hydraulic gradient and conductivity. Thus, when the water table lies within the peat layer, there is little wetland contribution to streamflow, but when the water table lies above the ground during intense storms, streamflow is increased rapidly by surface flow on the wetlands. (Author's abstract)
W87-06380

AIRBORNE CLOUD-PHYSICS PROJECTS FROM 1974 THROUGH 1984,
Naval Research Lab., Washington, DC.
For primary bibliographic entry see Field 2B.
W87-06554

WIND-DRIVEN ICE-PUSH EVENT IN EASTERN LAKE ONTARIO,
Queen's Univ., Kingston (Ontario). Dept. of Geography.
R. Gilbert, and J. R. Glew.
Journal of Great Lakes Research JGLRDE, Vol. 12, No. 4, p 326-331, 1986. 7 fig, 8 ref.

Descriptors: *Limnology, *Ice breakup, *Ice drift, *Ice jams, *Lake ice, *Wind effects, *Lake Ontario, Coastal waters, Erosion, Kinetic energy, Temperature effects, Lakes, Ice.

Ice on Lake Ontario at Kingston weakened rapidly in warm air temperatures to 17 C on the afternoon of 26 March 1986. Moderate onshore winds to 33 km/h changed to offshore winds during the night, and by morning most of the ice in the nearshore area had blown more than 5 km offshore. After 0600 on the morning of 28 March winds shifted to an obliquely on-shore direction, increasing to 28 km/h by noon and driving the ice on shore. A small ice-push event occurred at 1225 lasting 10 minutes, piling ice to a height of 2.5 m above the bank by successive overriding. Eleven stones of up to 206 kg were moved from the shore by the body of the ice and carried up, in some cases, to near the top of the ice pile, despite the weakness of the thin, candled ice sheet. The need for quantitative studies of these irregular and unpredictable events is demonstrated by these observations. (Author's abstract)
W87-06585

GLACIAL AND GLACIOLACUSTRINE EVENTS IN NORTHWESTERN LAKE HURON, MICHIGAN AND ONTARIO,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
P. F. Karrow.
Geological Society of American Bulletin BUGMA, Vol. 98, No. 1, p 113-120, January 1987. 7 fig, 42 ref.

Descriptors: *Ice drift, *Lake Huron, *Glacial drift, *Glacial lakes, *Glacial sediments, Michigan, Ontario, Lakes, Deglaciation.

Data on ice flow direction compiled from the literature reveal two glacial flow directions in northwestern Lake Huron. Superior ice flowed southeast across the Michigan upper peninsula and northeastern lower Michigan, and Algoma ice flowed southwest across the Ontario main land and the Sugar- St. Joseph-Drummond- Manitoulin Island group. Sandy calcareous till covers most of the area and it is commonly drumlinized. Grain size, carbonate content, and heavy mineral assemblages provide no distinction between Superior and Algoma tills. A succession of glacial and post glacial lake levels affected the area. Plane table profiles show that on St. Joseph Island, most of the Algonguin succession can be identified by correlation with published data from Sault Ste. Marie and Maitoulin Island. These shorelines slope up to the north at 1 m per km and are truncated by Nipissing and Algoma strandlines. Deglaciation of the region occurred between the Onaway Advance (11,800 yr. B.P.) and the Marquette Advance (10,000yr B.P.). Ice retreat took place as Lake Algonquin spread northward, leaving a series of shorelines during isostatic uplift and opening of the sequence of outlets near North Bay, Ontario. The Nipissing transgression is marked by buried wood and peat 7,300 to 5,900 yr old and by the development of a prominent shoreline above the present lake level. (Authors's abstract)
W87-06588

2D. Evaporation and Transpiration

EVAPOTRANSPIRATION ESTIMATES DERIVED FROM SUBSOIL SALINITY DATA,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
A. D. Matthias, H. M. Hassan, Y. Q. Hu, J. E. Watson, and A. W. Warrick.
Journal of Hydrology JHYDA7, Vol 85, No. 3/4, p 209-223, July 1986. 7 fig, 4 tab, 16 ref.

Descriptors: *Evapotranspiration, *Subsoil, *Salinity, *Model studies, *Irrigation, Hardpan soils, Soil horizons, Soil types, Consumptive use, Chemical properties, Safford, Arizona, Precipitation, Leaching.

A method for estimating past evapotranspiration (ET) rates from irrigated fields is described. It is based on the assumption that salt concentrations below the crop root zone are a function of the flux of naturally occurring salts applied by irrigation at the soil surface and the rate of soil water depletion due to ET. Thus, from irrigation histories and subsoil salinity data, ET rates may be calculated. For irrigated fields with low leaching fractions, corrections to the ET estimates may be necessary due to chemical precipitation. This is done through modeling of solution chemistry or from the use of observed chloride concentrations in solution. ET estimates for 1976-1980 for cotton at Safford, Arizona were made from subsoil salinity data. The average seasonal ET was found to be 1.04 m which was only 2% below the average seasonal ET estimated by the modified Blaney-Criddle method. The estimated ET for cotton was on average 0.48 of the seasonal pan evaporation and 0.76 of the annual irrigation plus rainfall amount. The method appears to be suitable for use in selected semi-arid and arid areas with relatively uniform soils and deep water tables. (Author's abstract)
W87-06296

STUDY OF EVAPORATION FROM TROPICAL RAIN FOREST - WEST JAVA,
Institute of Hydrology, Wallingford (England).
I. R. Calder, I. R. Wright, and D. Murdiyarso.
Journal of Hydrology JHYDA7, Vol. 89, No. 1/2, p 13-31, December, 1986. 10 fig, 2 tab, 31 ref.

Descriptors: *Evapotranspiration, *Hydrologic budget, *Model studies, *Evaporation, *Tropical rain forest, *Interception, Java, Soil moisture, Stochastic wetting function, Net rainfall, Statistical models, Transpiration.

Measurements of transpiration and interception loss were made from a region of secondary lowland tropical rain forest located in the Janlappa nature reserve, West Java, using soil physical and water balance methods. For the period of observation, the mean daily transpiration rate was 2.6 mm/day (soil-moisture tensions were < 1 bar), a rate which would be obtained with a constant surface resistance of 120 s/m. Interception models of the Rutter type, in which net-rainfall rate is related uniquely to canopy storage, were unsatisfactory. Better results were obtained with models using a stochastic wetting function. Measurements of rain and net rainfall indicated that interception losses were 21% of the gross rainfall. The calculated total evaporation from the site for the year from August 1980 to July 1981 was 1481 mm (886 mm transpiration and 595 mm interception), a value for which the latent heat requirement is identical to the measured net radiational input to the site. (Author's abstract)
W87-06375

WHAT ARE THE LIMITS ON FOREST EVAPORATION - A FURTHER COMMENT,
Institute of Hydrology, Wallingford (England).
I. R. Calder.
Journal of Hydrology JHYDA7, Vol. 89, No. 1/2, p 33-36, December, 1986. 10 ref.

Descriptors: *Evaporation, *Evapotranspiration, *Forests, *Atmospheric water, Feedback.

The interaction between the evaporation from wet forests and atmospheric conditions is discussed. Consideration of the (limited) relevant evidence suggests that, although firm conclusions are not possible, it is unlikely that the 'feedback' is as strong as that proposed by Morton. Experimental studies are proposed to investigate this important phenomenon. (Author's abstract)
W87-06376

SPRINGTIME EVAPORATION FROM BARE AND STUBBLE-COVERED SOIL,
North Dakota State Univ., Fargo. Dept. of Soil Science.
L. J. Brun, J. W. Enz, J. K. Larsen, and C. Fanning.
Journal of Soil and Water Conservation JWSCA3, Vol. 41, No. 2, p 120-122, March-April 1986. 3 fig, 1 tab, 7 ref.

Descriptors: *Soil cover, *Evaporation, *Model studies, *Soil surfaces, *Precipitation, Wind, Statistical models, Solar radiation, Temperature.

Differences in cumulative evaporation from a bare soil and a stubble-covered surface were related to precipitation amount and frequency. For relatively infrequent and small precipitation events there was little or no difference in cumulative evaporation. However, larger and more frequent precipitation events resulted in less cumulative evaporation from soil protected by stubble. Simple statistical models using wind, air temperature, and solar radiation explained 63% and 69%, respectively, of the variation in evaporation from the stubble-covered and bare soil surfaces, the day after precipitation events. Wind was the most significant factor. Most evaporative loss was from the 1-cm layer during the day after precipitation, with a steady evaporative rate of about 0.05 cm/day occurring 2 to 3 days later. (Author's abstract)
W87-06400

TROPICAL DEFORESTATION AND EVAPOTRANSPIRATION,
Georgia Univ., Athens. Inst. of Ecology.
J. C. Luvall, G. Parker, and C. Jordan.
IN: Symposium on Tropical Hydrology and 2nd Caribbean Islands Water Resources Congress, Proceedings of the International Symposium, May 5-8, 1985. San Juan, Puerto Rico. 1985. p 7-10, 2 tab, 3 ref.

Descriptors: *Tropical regions, *Deforestation, *Evapotranspiration, Logging, Clear-cutting, Forestry, Precipitation, Soil water.

Tropical deforestation may have the potential to alter global or regional climate. One of the parameters need by modelers attempting to predict climatic change is the rate at which evapotranspiration (ET) recovers following cutting of tropical forests. The objective of this study was to determine this parameter for one of the disturbances in tropical forests, clear cut logging. The forest, as classified by the Holdridge Life Zone System, is geographically and bioclimatically in a transition between Tropical Wet Forest and Premontane Wet Forest life zones. The mean annual precipitation is 4007 mm + or - 743 mm (n = 26 years). The canopy of the plot was dominated by Pentaclethra macroloba with Euterpe macrospadix present in the subcanopy and had a total basal area of 40.5 sq m/ha. Daily evapotranspiration was measured using the Penman-Monteith evaporation equation, which integrates both the environmental and plant factors important in determining evapotranspiration. Soil moisture was monitored using 12 paired soil tensiometers at 40 and 90 cm depth. Data were collected from the control primary forest for six months preceeding the cut and continued for six months after the cut for both the control forest and the cut area. The most significant finding was that five to six months after cutting, the monthly total ET from the cut area was only about 20-23% less than from the primary forest canopy. The results indicated that if these forests are allowed to recover following this type of cutting ET quickly recovers. Clear cut logging followed by abandonment and no disturbance is relatively rare in the tropics. Results probably represent a relatively short recovery time for ET compared to other types of disturbances. (See also W87-06455) (Lantz-PTT)
W87-06457

2E. Streamflow and Runoff

ENERGY SOURCES FOR DETRITIVOROUS FISHES IN THE AMAZON,
Instituto Nacional de Pesquisas da Amazonia, Manaus (Brazil).
For primary bibliographic entry see Field 2H.
W87-06017

COMPARATIVE TOXICOLOGICAL STUDY ON PIKE (ESOX LUCIUS L.) FROM THE RIVER RHINE AND RIVER LAHN,
Marburg Univ. (Germany, F.R.). Inst. of Toxicology and Pharmacology.
For primary bibliographic entry see Field 5C.
W87-06036

TRACE METAL TRANSPORT IN TWO TRIBUTARIES OF THE UPPER CHESAPEAKE BAY: THE SUSQUEHANNA AND BUSH RIVERS,
Florida Univ., Gainesville. Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5B.
W87-06060

DEVELOPMENT OF THE TWO-DIMENSIONAL INTERRILL FLOW COMPONENT FOR AGRICULTURAL RUNOFF MODELS,
Kansas Univ., Lawrence. Dept. of Civil Engineering.
E. C. Pogge, A. D. Parr, and S. A. Limback.
Available from the National Technical Information Service, Springfield, VA 22161 as PB87 131785/AS, Price codes: A08 in paper copy, A01 in microfiche. Kansas Water Resources Research Institute, Lawrence, Contribution No. 250, September 1985. 150 p, 43 graphs, 11 ref, 2 append. Contract No. 14-08-0001-G907, Project No. USGS G907-05.

Descriptors: *Interrill flow, *Agricultural runoff, Overland flow, Model studies, Hydrologic models, Finite element analysis, Pesticide transport models, Two-dimensional flow.

Current models of pesticide transport are based on one-dimensional overland flow models which do not account for the presence of rills. Rills generate two-dimensional flow regimes in the regions between the rills. Herein are there models for solving the two-dimensional flow regime generated by a constant rainfall on a uniform inter-rill region. Two of the models, the transient and steady-state cases, involved applying finite element methods to systems of partial differential equations (Navier-Stokes). The finite element methods used were unsuccessful in obtaining solutions. The third model is based on the assumption that if the duration of constant rainfall and the longitudinal length of a uniform inter-rill area are both long enough, then at some location, the longitudinal discharge is constant; i.e., the lateral outflow into the rill is equal to the lateral inflow due to rainfall, per unit length. This condition produces a region that is longitudinally uniform (l.u.), that is, along any longitudinal line, the velocity and depth of flow are constant. The resulting l.u. model is a system of ordinary differential equations which are successfully solved by an initial value predictor/corrector method, to give the 2-D velocity components and water depth along any longitudinal line. Results show that, except under extreme conditions, the interrill l.u. flow regime is laminar. The small water depths produced by l.u. flow imply that l.u. flow is a good approximation, even if the total longitudinal length of an interrill area is less than the relatively long longitudinal distance of travel of l.u. streamlines generated by the l.u. model. This model can be incorporated into agricultural runoff models in order to account more accurately for the flow regime produced by rills. (Pogge-KSU,WRRI)
W87-06096

SECONDARY CIRCULATION IN NATURAL STREAMS,
Illinois State Water Survey Div., Champaign. Surface Water Section.
M. Demissie, T. Soong, N. G. Bhowmik, W. P. Fitzpatrick, and W. H. C. Maxwell.
Available from the National Technical Information Service, Springfield, VA 22161 as PB87 131702/AS, Price codes: A05 in paper copy, A01 in microfiche. Illinois Water Resources Center, Urbana-Champaign, UIUC-WRC-86-200, WRC Research Report No. 200, July 1986. 93 p, 38 fig, 4 tab, 59 ref. Contract No. INT 14-08-0001-G904, Project No. USGS G904-02.

Descriptors: *Computer models, *Secondary circulation, *Streams, Data acquisition, Model studies, Secondary current, Transverse current, Velocity, Illinois, Sangamon River, Data collection.

Secondary circulation which is sometimes referred to as secondary flow, secondary current or transverse current is an important phenomenon in natural streams and plays an important role in many natural processes in streams such as stream channel meander, bank erosion, bed scour, resuspension, and movement of sediment. Secondary circulation is that component of flow which is not in the main flow direction and is small as compared to the main flow velocity. A computerized data collection system for secondary circulation data acquisition in natural streams was developed and utilized in the field. The system includes an electromagnetic current meter, a micro-computer, an interface between the computer and the current meter, and a specially designed supporting structure. Secondary circultion data was collected in the Sangamon River near Mahomet, Illinois, utilizing the data collection system. A mathematical model for secondary circulation based on an existing model has been developed and tested against the data collected in the field. Model results generally reproduce similar secondary circulation patterns as observed from the field data but over-estimate the magnitudes of the velocities. (Stout-IL WRC)
W87-06100

STATE OF THE ART IN HYDROLOGIC FORECASTING: WHAT NEXT,
For primary bibliographic entry see Field 2A.
W87-06240

APPLICATION OF STREAMFLOW FORECASTS TO OPERATING A MULTI-RESERVOIR SYSTEM IN CENTRAL ARIZONA,
HyMet Co., Seattle, WA.
W. Tangborn, J. L. Keane, and K. M. Leytham.
IN: A Critical Assessment of Forecasting in Water Quality Goals in Western Water Resources Management, Proceedings of a Symposium held in Seattle, Washington, June 11-13, 1984. 1985. p 73-81, 4 fig, 1 ref.

Descriptors: *Streamflow, *Forecasting, *Reservoir operations, *Arizona, *Salt River, *Verde River, *Streamflow forecasting, Model studies, Computer models, HYMET, Simulation analysis, Hydrologic models.

A short-term streamflow forecasting model that uses only standard meteorological observations (daily precipitation and temperature) has been developed for the Salt and Verde Rivers, to be used by the Salt River Project for reservoir management. The HYMET Model is designed to forecast mean six hourly stream discharges for forecast periods of 36-72 hours usinng six hourly forecasts of precipitation and temperature. This simulation model is deterministic and continuously calculates the watersheds' snowpack water content, snow covered area, soil moisture storage and other hydrologic variables that affect stream discharge. Six precipitation stations and three temperature stations were selected to represent the climate in the two watersheds. Six hour data are used when available. At other times, daily precipitation is averaged by assigning pre-determined weights to each station, then it is disaggregated into six hour increments using frequency distributions of daily precipitation in this region. Six hour mean temperatures are obtained by constructing a sinusoidal temperature distribution from the daily maximums and minimums. Real time applications of the model will allow the operator to adjust the initial watershed conditions prior to the storm. Precipitation and temperature forecasts can be varied to produce a probable range of discharges. (See also W87-06238) (Author's abstract)
W87-06247

ANALYSIS OF SEASONAL VOLUME STREAMFLOW FORECAST ERRORS IN THE WESTERN UNITED STATES,
Soil Conservation Service, Portland, OR.
B. A. Shafer, and J. M. Huddleston.
IN: A Critical Assessment of Forecasting in Water Quality Goals in Western Water Resources Management, Proceedings of a Symposium held in Seattle, Washington, June 11-13, 1984. 1985. p 117-

126, 10 fig, 2 tab, 10 ref.

Descriptors: *Seasonal variation, *Streamflow forecasting, *Data interpretation, Forecasting, Statistical analysis, Streamflow, Long-term planning, Statistical methods.

A database comprising some 50,000 seasonal streamflow forecast errors from 10 states in the Western U.S. was assembled. Over 500 individual forecast points were represented. These data were analyzed to establish mean error values, characterize error distribution, relate average error to natural variability in streamflow, and examine trends in forecast skill. Mean forecast errors were calculated for each state. The average April 1 forecast error for the Western U.S. is about 19%. Forecast errors were found to be evenly divided between positive and negative categories and approximately normally distributed. An equation was developed describing average state forecast error as a function of average streamflow coefficient of variation. This equation explained 97% of the variance in average state forecast error. A downward trend in forecast accuracy was not conclusively proven. However, about a 10% relative improvement in forecasting skill in recent years compared to a long-term average was inferred. (See also W87-06238) (Author's abstract)
W87-06251

FORECASTING SEASONAL RUNOFF FOR HYDROELECTRIC OPERATIONS USING SIMULATED WATER STORAGE,
HyMet Co., Seattle, WA.
For primary bibliographic entry see Field 2A.
W87-06252

WATER MARKETS FOR STREAM FLOW AUGMENTATION,
Washington State Univ., Pullman. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6D.
W87-06254

PROGRESS ON THE DELAWARE RIVER CLEAN-UP PROGRAM,
Philadelphia Water Dept., PA.
For primary bibliographic entry see Field 5G.
W87-06271

EVALUATION OF SOME REAL-TIME TECHNIQUES FOR CONTROLLING COMBINED SEWER OVERFLOWS,
Quebec Univ., Montreal. Dept. of Physics.
For primary bibliographic entry see Field 5G.
W87-06284

RIVER BASIN WATER QUALITY MONITORING NETWORK DESIGN,
Old Dominion Univ., Norfolk, VA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7A.
W87-06285

SEPARATION OF A STORM HYDROGRAPH INTO RUNOFF COMPONENTS BY BOTH FILTER SEPARATION AR METHOD AND ENVIRONMENTAL ISOTOPE TRACERS,
Tokyo Inst. of Tech. (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W87-06298

TRANSPORT OF TRACER GRAVELS ON A COASTAL CALIFORNIA RIVER,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
For primary bibliographic entry see Field 2J.
W87-06299

DISCRETE KERNEL SIMULATION MODEL FOR CONJUNCTIVE MANAGEMENT OF A STREAM-AQUIFER SYSTEM,
Colorado Univ. at Boulder. Dept. of Civil, Environmental, and Architectural Engineering.
For primary bibliographic entry see Field 4B.
W87-06302

NON-LINEAR RUNOFF ROUTING - A COMPARISON OF SOLUTION METHODS,
Rhodes Univ., Grahamstown (South Africa). Hydrological Research Unit.
D. A. Hughes, and H. C. Murrell.
Journal of Hydrology JHYDA7, Vol 85, No 3/4, p 339-347, July 30, 1986. 1 fig, 1 tab, 17 ref.

Descriptors: *Model studies, *DVERK, *Mathematical equations, *Runoff, *Rainfall-runoff relationships, *Rainfall, Storage, Reservoir storage, Precipitation, Rain, Performance evaluation.

Solutions the non-linear input-storage-discharge model were investigated with respect to their accuracy and efficiency, using four different methods. As there are no analytical solutions, except when n = 1/2 or 1, solutions were obtained numerically. The acceptability of the different methods depended upon the time step over which the equations were solved as well as the value of the parameters involved. Three of the methods have been reported in the literature and previously used in deterministic catchment model formulations. The fourth is based upon an I.M.S.L. subroutine, DVERK, and proved to be the most accurate and efficient. (Author's abstract)
W87-06303

STUDY OF SOIL EROSION ON VERTISOLS OF THE EASTERN DARLING DOWNS, QUEENSLAND, II: THE EFFECT OF SOIL, RAINFALL, AND FLOW CONDITIONS ON SUSPENDED SEDIMENT LOSSES,
Queensland Dept. of Primary Industries, Toowoomba (Australia). Wheat Research Inst.
For primary bibliographic entry see Field 2J.
W87-06386

SPRING RUNOFF RETENTION IN PRAIRIE POTHOLE WETLANDS,
South Dakota Cooperative Fishery Research Unit, Brookings.
For primary bibliographic entry see Field 2H.
W87-06401

ORGANOCHLORINE INSECTICIDES IN TROUT, SALMO TRUTTA FARIO L., TAKEN FROM FOUR RIVERS IN LEON, SPAIN,
Universidad de Leon (Spain). Dept. of Biochemistry.
For primary bibliographic entry see Field 5B.
W87-06423

SEASONAL TOXICITY OF AMMONIA TO FIVE FISH AND NINE INVERTEBRATE SPECIES,
Environmental Research Lab.-Duluth, Monticello, MN. Monticello Ecological Research Station.
For primary bibliographic entry see Field 5C.
W87-06427

RESTORATION OF RIVERS AND STREAMS: THEORIES AND EXPERIENCE.
For primary bibliographic entry see Field 5G.
W87-06435

WATER QUALITY RESTORATION AND PROTECTION IN STREAMS AND RIVERS,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W87-06436

USE OF MEANDER PARAMETERS IN RESTORING HYDROLOGIC BALANCE TO RECLAIMED STREAM BEDS,
Wyoming Univ., Laramie. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W87-06437

RIPARIAN REVEGETATION AS A MITIGATING PROCESS IN STREAM AND RIVER RESTORATION,
Arizona State Univ., Tempe. Center for Environmental Studies.
For primary bibliographic entry see Field 5G.
W87-06438

MECHANISMS OF COLONIZATION AND HABITAT ENHANCEMENT FOR BENTHIC MACROINVERTEBRATES IN RESTORED RIVER CHANNELS,
Tulsa Univ., OK. Faculty of Natural Sciences.
For primary bibliographic entry see Field 5G.
W87-06439

RUNOFF DISPOSAL IN THE LIMESTONE REGION OF NORTHERN P.R.,
Geotec, Caparra Heights, PR.
For primary bibliographic entry see Field 4A.
W87-06461

GENERAL HYDROLOGY AND WATER QUALITY OF LAYOU RIVER IN DOMINICA, BUCCAMENT RIVER IN ST. VINCENT, AND TROUMASSEE RIVER IN ST. LUCIA, BRITISH WEST INDIES,
P. L. Diaz, A. Lugo, and W. McDowell.
IN: Symposium on Tropical Hydrology and 2nd Caribbean Islands Water Resources Congress, Proceedings of the International Symposium, May 5-8, 1985, San Juan, Puerto Rico. p 46-49, 3 fig, 2 tab, 2 ref.

Descriptors: *Streamflow, *Layou River, *Buccament River, *Troumassee River, *St. Vincent, *St. Lucia, *Dominica, *Rainfall-runoff relationships, Hydrologic properties, Watersheds, Resources development, Suspended sediment, Water quality.

A 2-year water resources investigation to collect baseline-hydrologic data in the Caribbean Islands of Dominica, St. Vincent and St. Lucia, was initiated in October 1983. Three watersheds were selected, one from each island to define the annual variation of principal chemical constituents of river waters, and suspended sediment concentrations with changes in streamflow. Continuously-recording gages were established on each watershed to monitor streamflow and rain gage. Water samples were collected on a regular basis for sediment and chemical analyses. Based on nine months of record, the average monthly discharge of these watersheds were: 290 cu ft/sec in Layou River, Dominica; 32 cu ft/sec in Buccament River, St. Vincent, and 20 cu ft/sec in Troumassee River, St. Lucia. Rainfall is relatively high as compared to Caribbean Islands and varies from 60 in/yr in the coastal plains to 200 in/yr in the interior. Suspended sediment concentrations range from 0 mg/L to 654 mg/L. Preliminary water quality analyses indicate that waters from the watersheds could be similar to that of rainforest areas in Puerto Rico. (See also W87-06455) (Lantz-PTT)
W87-06465

FLOODS OF APRIL 18, 1983 ON ST. THOMAS AND ST. JOHN, U.S. VIRGIN ISLANDS,
R. E. Curtis.
IN: Symposium on Tropical Hydrology and 2nd Caribbean Islands Water Resources Congress, Proceedings of the International Symposium, May 5-8, 1985, San Juan, Puerto Rico. p 90-95, 5 fig, 1 tab, 4 ref.

Descriptors: *Floods, *St. Thomas, *St. John, *Virgin Islands, *Rainfall-runoff relationships, Flood damage, Flood forecasting, Flooding, Sediment transport.

Severe flooding as a result of intense rainfall occurred in St. Thomas and St. John, U.S. Virgin Islands on April 18, 1983. Rainfall intensities of 2.5 in/hr, and more than 16 in in 18 hrs were recorded at St. Thomas and St. John. The almost instantaneous runoff turned the usually dry streams on both islands into raging rivers of sediment-laden water and debris. The flood heights were measured at the

two stream-gaging stations on St. Thomas and the one on St. John. Based on data for similar streams in Puerto Rico, flooding of this magnitude can be expected to occur on the average less than once every one-hundred years. The effects of sediment and debris on the flood peaks cannot be fully evaluated because of lack of data. However, it is likely that runoff rates and volumes are subject to more error than normal because of the unknown effects of these factors. Federal Emergency Management Administration officers estimated the damages on St. Thomas and St. John at 3.5 million dollars to structures and contents, 5 million dollars to public works and schools, and 4 million dollars to roads, bridges and culverts. (See also W87-06455) (Lantz-PTT)
W87-06474

EFFECT OF CHANGE IN LANDUSE ON DESIGN FLOODS OF RURAL CATCHMENTS OF SEMI-ARID NORTH-EAST BRAZIL,
Universidade Federal da Paraiba, Joao Pessoa (Brazil).
For primary bibliographic entry see Field 4C.
W87-06476

QUANTIFYING FLOOD DISCHARGES IN MOUNTAINOUS TROPICAL STREAMS,
V. B. Sauer, R. E. Curtis, L. Santiago-Rivera, and R. Gonzalez.
IN: Symposium on Tropical Hydrology and 2nd Caribbean Islands Water Resources Congress, Proceedings of the International Symposium, May 5-8, 1985, San Juan, Puerto Rico. p 104-108, 9 ref.

Descriptors: *Flood discharge, *Mountains, *Flood flow, *Mathematical studies, *Step-backwater method, *Stage-discharge relations, Tropical regions, Surface runoff, Mathematical equations, Flow rates.

Many tropical island streams flow in high gradient, rough channels. Trees and large boulders are not uncommon in these channels, and flow during floods is typically turbulent and unstable. To provide needed hydrologic data in the tropics, it is important that flood discharges and hydrographs be determined for many sites. Several problems make it difficult, if not impossible, to measure flood flows by the conventional method of depth sounding and current meter. High velocity and excessive turbulence results in inaccuracies of depth and velocity. Rapid changes in stage do not allow sufficient time to traverse the stream for a conventional current-meter measurement. The step-backwater method of computing water-surface profiles can be used to develop stage-discharge relations in mountainous tropical streams. The method is especially useful where conventional current-meter measurements cannot be obtained. Based on this and other studies, the step-backwater ratings should be accurate to within 15 to 20%. A possible enhancement to the method is a direct computation of the Manning roughness coefficient. A simplified slope-area method, which does not require an estimate of Manning's roughness coefficient, can be used to compute flood discharges in uniform channels where little or no overbank flow occurs. Accuracy may be equivalent to the conventional slope-area method. More study is needed to further develop this method for use in the tropics. (See also W87-06455) (Lantz-PTT)
W87-06477

HYDROLOGIC SOLUTION FOR URBAN FLOODING IN TERESINA, BRAZIL,
For primary bibliographic entry see Field 4A.
W87-06478

APPROACH TO FLOOD SIMULATION OF COMPLEX FLOODPLAINS,
Army Engineer District, Jacksonville, FL.
J. E. Gurule.
IN: Symposium on Tropical Hydrology and 2nd Caribbean Islands Water Resources Congress, Proceedings of the International Symposium, May 5-8, 1985, San Juan, Puerto Rico. p 114-118, 7 ref.

Descriptors: *Simulation analysis, *Flood discharge, *Flood plains, *Model studies, *Mathematical studies, Flood channels, Flood control, Mathematical models, Computer models.

Simulating the hydrodynamics of flood events, whether actual or ypothetical, on large and complex floodplains, can present difficult problems to the analyst. Flood discharges that exceed main channel capacities and are influenced by floodplain irregularities such as discontinuous levees, diversion, split flows, unusual topography, can be extremely difficult to model mathematically using one-dimensional methodologies. Under these circumstances, flood events are better analyzed by methods that can account for flow variations as they exist and not 'averaged' to fit traditional one-dimensional procedures. The goal of this paper is to present an approach that addresses these conditions with a measure of authenticity by mathematically describing these variations in a more realistic and logical modeling capability. The approach utilizes a link/node method that formulates into an interconnecting network that forms a horizontal pseudo-two-dimensional description of a floodplain. (See also W87-06455) (Author's abstract)
W87-06479

FLASH-FLOOD PREDICTION SYSTEM,
National Weather Service, Silver Spring, MD. Hydrologic Research Lab.
K. P. Georgakakos.
IN: Symposium on Tropical Hydrology and 2nd Caribbean Islands Water Resources Congress, Proceedings of the International Symposium, May 5-8, 1985, San Juan, Puerto Rico. p 121-124, 14 ref.

Descriptors: *Flood forecasting, *Flash floods, *Model studies, Computer models, Simulation analysis, Integrated Hydrometeorological Forecast System, Performance evaluation.

A flash-flood prediction system, called IHFS (Integrated Hydrometeorological Forecast System), was developed and is undergoing tests simulating real-time conditions. The system couples a local, quantitative precipitation forecast model with an API procedure and a channel router. An updating mechanism corrects the model states in real-time utilizing observed precipitation and discharge data. The system is suitable for implementation at the local site on mini- or micro-computers. Optimal system performance is attained when high frequency data are obtained from both precipitation and stage (or discharge) automated sensors in real time. IHFS is expected to be particularly useful in tropical climates due to the capability of the precipitation component to model convective storms better. With minor modifications, IHFS can be used for the prediction of urban flooding. (See also W87-06455) (Lantz-PTT)
W87-06480

MODELING VIRGIN ISLANDS FLOOD HYDROLOGY USING HYMO,
CH2M Hill, Inc., Gainesville, FL.
J. E. Scholl, and R. L. Wycoff.
IN: Symposium on Tropical Hydrology and 2nd Caribbean Islands Water Resources Congress, Proceedings of the International Symposium, May 5-8, San Juan, Puerto Rico. 1985. p 139-142, 2 tab, 7 ref.

Descriptors: *Flooding, *Hydrologic models, *Virgin Islands, *Computer models, Mathematical studies, Streamflow, *Rainfall-runoff relationships, Flood hydrograph, Model studies, Watersheds.

A significant potential for flooding problems exists on many Caribbean islands. Two types of flooding conditions may occur either independently or in combination: coastal or inland flooding. This paper deals only with inland or riverine based flooding. In the U.S. Virgin Islands, the potential for inland flooding is strenghthened by the steep mountain slopes, a dominance of clay soils, the absence of perennial streamflow and the potential for high volume and intense rainfall. These natural factors combine with man's tendency to develop the valuable flat lands adjacent to many inland stream channels which has resulted in frequent flood damage during the past 10 years. To develop a consistent basis for evaluating existing flooding problems and for planning activities to reduce future flood damage, a watershed modeling project was initiated in 1979 by the Disaster Programs Office of the Territory. The procedures utilized to model flood hydrology in the U.S. Virgin Islands, using the HYMO computer program for modeling runoff and sediment yield from watersheds are summarized. The results of hydrograph analyses performed using observed streamflow data the status off watershed modeling performed to date are presented. (See also W87-06455) (Author's abstract)
W87-06484

SAN LORENZO RIVER SEDIMENTATION STUDY: NUMERICAL MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 2J.
W87-06528

PERSPECTIVE ON STREAM COMMUNITY ORGANIZATION, STRUCTURE, AND DEVELOPMENT,
Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife.
For primary bibliographic entry see Field 2H.
W87-06559

2F. Groundwater

MULTICRITERIA MANAGEMENT OF GROUNDWATER QUALITY UNDER UNCERTAINTY,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W87-06099

GROUNDWATER CONTAMINATION PROBLEM AND RELATED RESEARCH,
Texas Univ. at Austin. Biomedical Engineering Lab.
For primary bibliographic entry see Field 5C.
W87-06156

GROUNDWATER POLLUTION MICROBIOLOGY,
For primary bibliographic entry see Field 5C.
W87-06201

GROUNDWATER POLLUTION MICROBIOLOGY: THE EMERGING ISSUE,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
For primary bibliographic entry see Field 5B.
W87-06202

ELEMENTS OF SOIL SCIENCE AND GROUNDWATER HYDROLOGY,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
H. Bouwer.
IN: Groundwater Pollution Microbiology, John Wiley and Sons, New York, New York, 1984. p 9-38, 14 fig, 1 tab, 30 ref.

Descriptors: *Groundwater, *Soil water, *Groundwater movement, Groundwater depletion, Groundwater recharge, Vadose water, Aquifers, Soil types, Soil classification, Wastewater treatment, Groundwater management.

Groundwater has only recently evolved from a 'secret and occult substance emanating from the bowels of the earth' to the more clearly understood water resource that it is today. In the United States alone, groundwater supplies about 25% of all water used. Sixty-nine percent of the groundwater pumped is for irrigation, 14% is for industry, 13% is for urban drinking water, and 5% is for rural drinking water. About 50% of the population in the United States relies on groundwater for drinking and 75% of municipal water supply sys-

tems use groundwater. This chapter summarizes aspects of soil science and groundwater hydrology with special reference to the occurrence, movement, and survival of microorganisms, through discussions on topics such as: (1) vadose zone and aquifers; (2) classification on soil materials; (3) groundwater quality and microorganisms; (4) water movement; and (5) land treatment of wastewater and groundwater management. (See also W87-096201) (Lantz-PTT)
W87-06203

SOURCES OF GROUNDWATER POLLUTION,
Texas Univ. Medical School at Houston. Program in Infectious Diseases and Clinical Microbiology.
For primary bibliographic entry see Field 5B.
W87-06204

MICROBIAL POLLUTANTS: THEIR SURVIVAL AND TRANSPORT PATTERN TO GROUNDWATER,
Arizona Univ., Tucson. Dept. of Microbiology and Immunology.
For primary bibliographic entry see Field 5B.
W87-06205

MICROBIAL ACTIVITY IN MODEL AQUIFER SYSTEMS,
Robert S. Kerr Environmental Research Lab., Ada, OK.
J. Wilson, and M. J. Noonan.
IN: Groundwater Pollution Microbiology, John Wiley and Sons, New York, New York, 1984. p 117-133, 5 fig, 3 tab, 19 ref.

Descriptors: *Microbiological studies, *Model studies, *Aquifers, *Fate of pollutants, Aquifer systems, Microcosms, Groundwater quality, Path of pollutants, Solute transport.

Ideally, a natural system should be studied directly and in its entirety, so that the components, processes, and interactions that comprise its structure and function can be described in a holistic and integrated manner. Unfortunately, constraints on physical and human resources make such an approach unfeasible in many natural systems. This is particularly true for the terrestrial subsurface. The cost of drilling sampling wells or bore holes can be inordinately expensive. Fortunately, the use of microcosms allows detailed study of the processes occurring in the subsurface environment without the need for a large number of wells or boreholes. A second advantage of microcosms is their flexibility. The components of a microcosm can be tailored to focus on particular processes or interactions. As a result, the design of a microcosm is usually keyed to the purpose of a particular study. Here, a subsurface, environmental microcosm is studied to learn about microbial activities in aquifer systems. Variability of conservative groundwater quality, variation in solutes in groundwater from igneous rocks, survival of bacteria in groundwater, and microcosms as physical models and their rational design, are all discussed. (See also W87-06201) (Lantz-PTT)
W87-06207

HEALTH ASPECTS OF GROUNDWATER POLLUTION,
Health Effects Research Lab., Cincinnati, OH.
For primary bibliographic entry see Field 5C.
W87-06208

MICROBIOLOGICAL ASPECTS OF GROUNDWATER POLLUTION DUE TO SEPTIC TANKS,
Mississippi State Univ., Mississippi State.
For primary bibliographic entry see Field 5B.
W87-06209

LAND DISPOSAL OF SEWAGE EFFLUENTS AND RESIDUES,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
For primary bibliographic entry see Field 5E.
W87-06210

MICROORGANISMS AS GROUNDWATER TRACERS,
Arizona Univ., Tucson. Dept. of Microbiology and Immunology.
For primary bibliographic entry see Field 5A.
W87-06211

MICROBIOLOGICAL SAMPLING IN THE ASSESSMENT OF GROUNDWATER POLLUTION,
Robert S. Kerr Environmental Research Lab., Ada, OK.
For primary bibliographic entry see Field 7A.
W87-06212

GROUNDWATER CONTAMINATION: DATA ANALYSIS AND MODELING,
Texas Univ. Health Science Center at Houston. School of Public Health.
For primary bibliographic entry see Field 5B.
W87-06213

BIOCHEMICAL INDICATORS OF GROUNDWATER POLLUTION,
Oklahoma State Univ., Stillwater. Dept. of Biochemistry.
For primary bibliographic entry see Field 5A.
W87-06214

U.S. FEDERAL LEGISLATION PERTAINING TO GROUNDWATER PROTECTION,
National Water Well Association, Worthington, OH.
For primary bibliographic entry see Field 5G.
W87-06215

GROUNDWATER QUALITY MODELLING,
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W87-06225

NUMERICAL MODELLING OF GROUNDWATER BASINS,
International Inst. for Land Reclamation and Improvement, Wageningen (Netherlands).
J. Boonstra, and N. A. Ridder.
International Institute for Land Reclamation and Improvement, P.O. Box 45, 6700 AA Wageningen, The Netherlands. ILRI Publication No. 29, 1981. 226 p, 71 fig, 27 tab, 41 ref, 3 append.

Descriptors: *Groundwater movement, *Mathematical models, *Groundwater basins, *Model studies, Model studies, Geohydrology, Mathematical equations, Irrigation, Aquifers.

With the advance of high-speed electronic computers, numerical models are being extensively used in analyzing groundwater flow problems. Yet, confusion and misunderstanding still surround their application, even though such famous old-timers as Laplace and Newton were long ago applying numerical techniques to solve physical problems. The model presented in this book can be used to predict the impact of man's interference in the hydrological equilibrium of a groundwater basin. It can simulate the effects of new irrigation schemes, new patterns and rates of groundwater abstraction, and artificial recharge of the basin, and can do so for any desired length of time. The model can be applied to an unconfined aquifer, a semi-confined aquifer, or a confined aquifer, or to any combination of these, provided that one type passes laterally into the other. The model cannot be used for multi-aquifer systems, i.e. aquifers overlying one another separated by impermeable or slightly permeable layers. Three-dimensional flow problems cannot be studied by the model. The primary aim of this book is to provide a practical guide for those involved in groundwater basin modeling, whether their training be in geology, hydrogeology, engineering, physics, or mathematics. (Lantz-PTT)
W87-06236

GROUND WATER AND UNDERGROUND TANKS: PAST PROBLEMS AND PRESENT SOLUTIONS,
ICF, Inc., Washington, DC.
For primary bibliographic entry see Field 5E.
W87-06289

CONTROLLING GROUND WATER POLLUTION FROM SEWAGE EFFLUENT DISPOSAL IN THE TUCSON AREA,
Pima County Dept. of Wastewater Management, Tucson, AZ.
For primary bibliographic entry see Field 5G.
W87-06290

CHEMICAL ENGINEERING TREATMENTS FOR CONTAMINATED GROUND WATER,
NUS Corp., Houston, TX.
For primary bibliographic entry see Field 5G.
W87-06292

AQUIFER PROTECTION PLANS: PREVENTING CONTAMINATION OF LOCAL PUBLIC WATER SUPPLIES,
Lexington-Fayette Urban County Government, KY. Dept. of Public Works.
For primary bibliographic entry see Field 5G.
W87-06293

GROUNDWATER MODEL OF THE BLUE RIVER BASIN, NEBRASKA - TWENTY YEARS LATER,
Geological Survey, Reston, VA.
W. M. Alley, and P. A. Emery.
Journal of Hydrology JHYDA7, Vol. 85, No. 3/4, p. 225-249, July 1986. 5 fig, 3 tab, 40 ref.

Descriptors: *Model studies, *Aquifers, *Groundwater, *Hydrology, Subsurface water, Blue River basin, Nebraska, Groundwater depletion, Depletion, Groundwater recession, Groundwater movement, Prediction.

Groundwater flow models are almost a routine tool of the practicing hydrologist. Yet, little attention is given to true verification analysis of studies using these models. This paper examines predictions of water-level declines and streamflow depletions that were made using an electric analog groundwater model of the Blue River basin in Nebraska. Analysis of the model's predictions suggests that the analog model used too low an estimate of net groundwater withdrawals, yet overestimated water-level declines. The model predicted that almost all of the net groundwater pumpage would come from storage in the Pleistocene aquifer within the Blue River basin. It appears the model underestimated contributions of other sources of water to the pumpage, and the aquifer storage coefficients used in the model were too low. There is some evidence that groundwater pumpage has had a greater than predicted effect on streamflow. Considerable uncertainty about the basic conceptualization of the hydrology of the Blue River basin greatly limits the reliability of groundwater models developed for the basin. The paper concludes with general perspectives on groundwater modeling gained from this post-audit analysis. (Author's abstract)
W87-06297

BOUNDARY ELEMENT - RANDOM WALK MODEL OF MASS TRANSPORT IN GROUNDWATER,
Kansas State Geological Survey, Lawrence.
M. Kemblowski.
Journal of Hydrology JHYDA7, Vol. 85, No. 3/4, p 305-318, July 1986. 9 fig, 10 ref.

Descriptors: *Model studies, *Path of pollutants, *Groundwater movement, *Groundwater, Subsurface water, Convection, Conduction, Dispersants.

A boundary element solution to the convective mass transport in groundwater was presented. The solution produces a continuous velocity field and reduces the amount of data preparation time and

bookkeeping. By combining this solution and the random walk procedure, a convective-dispersive mass transport model is obtained. This model could be used to simulate groundwater contamination problems. The accuracy of the boundary element model was verified by reproducing the analytical solution to a two-dimensional convective mass transport problem. The method has also been used to simulate a convective-dispersive problem. (Author's abstract)
W87-06301

DISCRETE KERNEL SIMULATION MODEL FOR CONJUNCTIVE MANAGEMENT OF A STREAM-AQUIFER SYSTEM,
Colorado Univ. at Boulder. Dept. of Civil, Environmental, and Architectural Engineering.
For primary bibliographic entry see Field 4B.
W87-06302

NUMERICAL SIMULATIONS BASED ON STREAM FUNCTIONS AND VELOCITIES IN THREE-DIMENSIONAL GROUNDWATER FLOW,
Dienst Grondwaterverkenning TNO, Delft (Netherlands).
W. Zijl.
Journal of Hydrology JHYDA7, Vol 85, No 3/4, p 349-365, July 1986. 12 fig, 8 ref, append.

Descriptors: *Groundwater movement, *Computer programs, *Velocity, *Model studies, *Simulation, Subsurface water, Advection, Streamflow, Storm seepage, Streams, Flow, Performance evaluation.

Accurate determination of the velocity of the carrier fluid percolating through the porous medium is extremely important, since the primary transport mechanism in a subsurface flow is advection. Computer-based groundwater motion simulators conventionally use pressure as the primary variable, and after the pressure field has been calculated, the velocity field is determined by numerical differentiation. Since this is an unreliable procedure, two alternatives are presented. The basic principles of both the stream functions approach and of the direct determination of the velocity field are presented. The stream functions approach was extended to three dimensions. A computer program was written for the method of direct determination of the velocity field. Numerical results are shown for this method and an application of it to determine subsurface flow systems is presented. Results indicate that the direct determination of the velocity field performs very satisfactorily. (Author's abstract)
W87-06304

DECAY OF A DISTURBED FREE SURFACE IN A POROUS LAYER WITH A SEMI-PERMEABLE BOTTOM,
Norges Landbrukshoegskole, Aas. Dept. of Physics and Meteorology.
P. A. Tyvand.
Journal of Hydrology JHYDA7, Vol 85, No 3/4, p 367-370, July 1986. 4 ref.

Descriptors: *Groundwater movement, *Groundwater, *Mathematical equations, *Water table, *Porous Media, *Permeability, Surface drainage, Stagnant water, Capillary water, Clogging.

The gravitational decay of a free surface of fluid in a porous layer is examined in terms of linear theory. Below the porous layer there is a stagnant, a fluid layer with hydrostatic pressure. A membrance is located at the interface between the porous layer and the fluid layer. By varying the membrane constant a smooth transition can be found between an open bottom and an impermeable bottom. (See also W87-06306) (Author's abstract)
W87-06305

INFLUENCE OF A BOTTOM FLUID LAYER ON THE DECAY OF A DISTURBED FREE SURFACE IN A POROUS MEDIUM,
Norges Landbrukshoegskole, Aas. Dept. of Physics and Meteorology.
P. A. Tyvand.
Journal of Hydrology JHYDA7, Vol 85, No 3/4, p 371-378, July 1986. 9 ref.

Descriptors: *Water table, *Groundwater, *Waves, *Porous media, *Groundwater movement, Permeability, Hydrology, Hydrostatic level, Water level, Artesian pressure, Physical properties, Fracture permeability, Geohydrologic units, Hydrodynamics.

Finding a criterion for the validity of the hydrostatic approximation for a fluid layer below a porous layer in which a free surface is decaying is described. According to the studies, hydrostatic approximation breaks down for sufficiently long waves. Travelling surface waves due to the inertia of the fluid layer are a possibility. Under favorable conditions such waves are able to propagate beyond their own wavelength before dying out. (See also W87-06305) (Author's abstract)
W87-06306

HYDROGEOLOGY OF THE CENTRAL MACKENZIE VALLEY,
Carleton Univ., Ottawa (Ontario). Ottawa-Carleton Centre for Geoscience Studies
F. A. Michel.
Journal of Hydrology JHYDA7, Vol 85, No 3/4, p 379-405, July 1986. 9 fig, 4 tab, 25 ref.

Descriptors: *Isotope studies, *Aquifers, *Mackenzie Valley, *Geochemistry, *Geohydrology, *Groundwater, Geology, Hydrology, Permafrost, Subsurface water, Precipitation, Snow, Radioisotopes, Frozen groundwater, Groundwater storage.

Using chemistry, field observations and a general knowledge of the geology in conjunction with environmental isotopes over 100 springs, seeps and mineralized ponds in the Mackenzie Valley were investigated. Precipitation (primarily snowmelt) was the source for all groundwaters sampled. Chemical analyses of the waters reveal three major components: Ca(2+) - SO4(2-), which dominates, Na(+) - Cl(-), and Ca(2+) - Mg(2+) - HCO3(-). The chemical data in combination with (34)S data indicate that the Devonian Bear Rock Formation is the major aquifer throughout the valley. Other important bedrock aquifers include the Mt. Kindle, Franklin Mountain and Saline River formations. Recharge is directly into bedrock through solution channels or karst systems within the Franklin Mountains. Discharge from the bedrock units is controlled by fold and fault structures. Permafrost is a major factor controlling groundwater recharge but does not significantly affect the location of groundwater discharge. (Author's abstract)
W87-06307

CHLOROFORM SORPTION TO NEW JERSEY COASTAL PLAIN GROUND WATER AQUIFER SOLIDS,
New Jersey Agricultural Experiment Station, New Brunswick.
For primary bibliographic entry see Field 5B.
W87-06310

SORPTION OF LOW-POLARITY ORGANIC COMPOUNDS ON OXIDE MINERALS AND AQUIFER MATERIAL,
Air Force Engineering and Services Center, Tyndall AFB, FL. Engineering and Services Lab.
For primary bibliographic entry see Field 2K.
W87-06350

CALCULATING THE IMPACT OF A MOMENTARY INPUT OF A DECAYING SOLUTE - AND ITS DECAY COMPONENTS - ON THE QUALITY OF OUTFLOWING GROUNDWATER,
Agricultural Univ., Wageningen (Netherlands). Dept. of Land and Water Use.
For primary bibliographic entry see Field 5B.
W87-06378

INVESTIGATIONS INTO THE FACTORS INFLUENCING LONG RANGE MATRIX DIFFUSION RATES AND PORE SPACE ACCESSIBILITY AT DEPTH IN GRANITE,
UKAEA Atomic Energy Research Establishment, Harwell (England). Chemistry Div.
For primary bibliographic entry see Field 5E.
W87-06383

PUMPING TEST USING LARGE-DIAMETER PRODUCTION AND OBSERVATION WELLS,
Komenskeho Univ., Bratislava (Czechoslovakia). Dept. of Hydrogeology.
I. Mucha, and E. Paulikova.
Journal of Hydrology JHYDA7, Vol. 89, No. 1/2, p 157-164, December, 1986. 3 fig, 14 ref.

Descriptors: *Model studies, *Groundwater, *Pumping tests, *Observation wells, *Production wells, *Well storage, *Aquifers, Well diameter, Calculations, Permeability, Mathematical models.

The course of drawdown during a pumping test (and recovery) is influenced by diameter of the production and observation wells. This factor cannot be negligible, particularly in arid regions where the proper estimation of storage coefficient, leakage, and conductivity is the key problem in groundwater investigation. The effect of well storage is important in aquifers of low storage and in aquifers where elastic storage and leakage are to be estimated. In aquifers of low permeability, well storage prolongs aquifer tests. To eliminate the influence of diameter of production and observation wells, a modeling method was employed. Curves resulting from the model suggested the importance of well storage of abstraction and of other wells in the cones of depression. Neglecting this can lead to erroneous interpretation of pumping tests. A method is described for adjusting for well diameter in the interpretation of pumping tests. (Author's abstract)
W87-06385

EFFECT OF IRRIGATED AGRICULTURE ON GROUNDWATER,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 5B.
W87-06409

EFFECT OF IRRIGATION OF GROUNDWATER QUALITY IN CALIFORNIA,
Schmidt (Kenneth D.), Fresno, CA.
For primary bibliographic entry see Field 5B.
W87-06410

IRRIGATION EFFECTS IN ARIZONA AND NEW MEXICO, BY G. V. SABOL,
For primary bibliographic entry see Field 5B.
W87-06411

IRRIGATION EFFECTS IN OKLAHOMA AND TEXAS,
For primary bibliographic entry see Field 5B.
W87-06412

IRRIGATION EFFECTS IN SIX WESTERN STATES,
URS Corp., San Bernardino, CA.
For primary bibliographic entry see Field 5B.
W87-06413

CONJUNCTIVE USE IN SEVIER RIVER SYSTEM, UTAH,
Provo City Water and Wastewater Dept., UT.
For primary bibliographic entry see Field 4B.
W87-06419

GROUNDWATER QUALITY AND MANAGEMENT: RESEARCH AND EXTENSION.
Cornell Univ. Agricultural Experiment Station, Ithaca, NY.
For primary bibliographic entry see Field 5G.
W87-06451

COMPILATION OF HYDROLOGIC DATA FROM DRILLING THE SALADO AND CASTILE FORMATIONS NEAR THE WASTE ISOLATION PILOT PLANT (WIPP) SITE IN SOUTHEASTERN NEW MEXICO,
Sandia National Labs., Albuquerque, NM.
For primary bibliographic entry see Field 7C.
W87-06452

SYMPOSIUM ON TROPICAL HYDROLOGY AND 2ND CARIBBEAN ISLANDS WATER RESOURCES CONGRESS.
American Water Resources Association, Bethesda, MD.
For primary bibliographic entry see Field 2A.
W87-06455

DEVELOPMENT OF GROUNDWATER IN KARST ZONES OF SOMALIA,
Berger (Louis) International, Inc., East Orange, NJ.
P. Roark.
IN: Symposium on Tropical Hydrology and 2nd Caribbean Islands Water Resources Congress, Proceedings of the International Symposium, May 5-8, San Juan, Puerto Rico. 1985. p 3-6, 4 ref.

Descriptors: *Karst hydrology, *Somalia, *Groundwater potential, *Geohydrology, Semitropical regions, Tropical regions, Wells, Minerals, Public participation, Economic aspects, Costs.

The development of groundwater in the karst formations of semitropical Somalia is characterized by generally low yields and water of high mineral content. Well yields vary considerably between sites and surface indicators of karstification are important factors in locating well sites. Hydrogeologic data is minimal and much of the initial project efforts were devoted to collecting baseline information. In order to reduce the high incidence of inoperable wells which is characteristic of many rural development situations shortly after the technological inputs of well construction are completed, emphasis was placed on increasing local village participation in the design and operations. Local participation integrated with a program of regular maintenance is expected to increase the well life and reduce long-term costs. Costs of groundwater development comparable to the Somalia situation can be expected to be high and primarily reflect high capital outlays for equipment capable of deep drilling in remote areas. (See also W87-06455) (Lantz-PTT)
W87-06456

EFFECT OF IRRIGATION MODERNIZATION ON GROUNDWATER BALANCE: SOUTH COAST OF PUERTO RICO,
For primary bibliographic entry see Field 3F.
W87-06459

RESPONSE OF AQUIFER TO MONSOON RAINFALL IN CENTRAL JAVA, INDONESIA,
Binnie and Partners, Lima (Peru).
For primary bibliographic entry see Field 2A.
W87-06464

ESTIMATING THE CAPACITY OF A SALTY LIMESTONE AQUIFER IN PUERTO RICO TO RECEIVE, STORE, AND RELEASE INJECTED FRESHWATER USING CHLORIDE MASS BALANCE,
For primary bibliographic entry see Field 4B.
W87-06466

WATER QUALITY AND CHEMICAL EVOLUTION OF GROUND WATER WITHIN THE NORTH COAST LIMESTONE AQUIFERS OF PUERTO RICO,
A. Roman-Mas, and R. W. Lee.
IN: Symposium on Tropical Hydrology and 2nd Caribbean Islands Water Resources Congress, Proceedings of the International Symposium, May 5-8, 1985, San Juan, Puerto Rico. 1985. p 57-62, 5 fig, 2 tab, 10 ref.

Descriptors: *Water quality, *Aquifers, *Limestone, *Puerto Rico, *Groundwater management, Coastal aquifers, Geochemistry, Water table, Dissolved solids, Bicarbonates, Chlorides, Model studies, Groundwater recharge.

Waters within the north coastal limestone aquifers are suitable for public supply, industrial and agricultural uses. For the artesian aquifer and the updip parts of the water table aquifer, calcium and bicarbonate are the dominant ionic species with total dissolved solids and chloride concentrations below 500 and 250 mg/L, respectively. In coastal areas of the water table aquifer, where a freshwater-saltwater mixing zone occurs, the calcium bicarbonate facie grade to a sodium-chloride facie. Within this zone, concentrations of total dissolved solids and chloride are greater than 250 and 500 mg/L respectively, affecting the suitability of the water for some uses. Geochemical models were constructed to determine the physical and chemical reasons for the prevailing water quality patterns of the north coast limestone aquifers. Models indicate that calcite and carbon dioxide dissolution, precipitation or degassing are the primary processes. The mixing of recharge water or saltwater with aquifer waters is an important feature within the water table aquifer. The models provide further evidence that support the circulation of groundwater within the north coast limestone. (See also W87-06455) (Author's abstract)
W87-06467

APPLICATION OF 222-RN IN MEASURING GROUNDWATER DISCHARGE TO THE MARTHA BRAE RIVER, JAMAICA,
Lamont-Doherty Geological Observatory, Palisades, NY.
K. K. Ellins, H. J. Simpson, and S. Mathieu.
IN: Symposium on Tropical Hydrology and 2nd Caribbean Islands Water Resources Congress, Proceedings of the International Symposium, May 5-8, 1985, San Juan, Puerto Rico. p 64-67, 2 fig, 1 tab, 5 ref.

Descriptors: *Groundwater movement, *Path of pollutants, *Martha Brae River, *Jamaica, *Radon, Radioisotopes, *Tracers, Aquifers, Subsurface drainage.

A geochemical technique, involving the measurement of 222-Rn was used to obtain information about the interaction between surface and subsurface flow regimes in the Martha Brae Drainage Basin in Jamaica. Radon-222, a naturally occurring radioisotope with a half-life of 3.825 days, is derived from 226-Ra incorporated in aquifer material. Since 222-Rn is present in much higher concentrations in the groundwater of Jamaica's Tertiary White Limestone aquifer than in surface flow, anomalously high concentrations of 222-Rn detected at various points along the axis of the Martha Brae River indicate groundwater influx to surface flow at those locations. (See also W87-06455) (Lantz-PTT)
W87-06468

DEVELOPMENT OF A FRESH WATER SUPPLY FROM THE WATER-TABLE AQUIFER ON A BARRIER ISLAND,
Geological Survey, Tuscaloosa, AL. Water Resources Div.
R. E. Kidd, and M. Planert.
IN: Symposium on Tropical Hydrology and 2nd Caribbean Islands Water Resources Congress, Proceedings of the International Symposium, May 5-8, 1985, San Juan, Puerto Rico. p 69-72, 3 fig, 2 ref.

Descriptors: *Water supply, *Water resources development, *Aquifers, *Saline-freshwater interfaces, *Dauphin Island, *Alabama, Water table, Test wells, Model studies, Groundwater level.

Dauphin Island is located about 4 miles offshore of mainland Mobile County, Alabama, and from the point of confluence of the waters of Mobile Bay, the Mississippi Sound, and the Gulf of Mexico and extends westward for about 15 miles. The island has an area of about 6 sq mi. The mean annual temperature is about 69 F. Average annual rainfall is about 68 inches. The island is underlain by more than 23,000 ft of coast plain sediments ranging in age from Jurassic to Holocene. Only the Pleistocene-Holocene age sediments are described by this study. Thirty-eight test wells were drilled in December 1984 on the eastern end of the island to define the limits of the water table aquifer. A modular three-dimensional finite-difference groundwater flow model developed by the U.S. Geological Survey was chosen for numerically modeling the aquifer. Groundwater flow within the aquifer was simulated using a bloc-centered finite-difference approach. Based on specific conductance values that indicated fresh water was flowing in the aquifer at the shoreline, the vertical connection between the aquifer and the salt water bodies had to be low enough to cause such flow. This was determined by simulating water levels above sea level some distance offshore. The simulation indicated that the fresh water was completely discharged to the sea within 400 ft of the shoreline. Pumping 0.6 Mgal/d with a recharge rate of 15 in/yr produced water levels of about 12.5 ft below sea level at each well. The clay layer underlying the aquifer should provide protection from coning of salt water where pumping has lowered water level below sea level. (See also W87-06455) (Lantz-PTT)
W87-06469

APPLICATION OF A GROUND-WATER FLOW DIGITAL MODEL IN EVALUATING ALTERNATE DEWATERING SYSTEMS IN THE RIO GRANDE DE ARECIBO ALLUVIAL VALLEY, PUERTO RICO,
For primary bibliographic entry see Field 4B.
W87-06482

MODELING OF SOLUTE TRANSPORT THROUGH GROUND-WATER SYSTEMS,
Dames and Moore, Golden, CO.
For primary bibliographic entry see Field 5B.
W87-06486

VACUUM AND PRESSURE TEST METHODS FOR ESTIMATING HYDRAULIC CONDUCTIVITY,
NUS Corp., Pittsburgh, PA. Cyrus Wm. Rice Div.
J. P. Orient, A. Nazar, and R. C. Rice.
Ground Water Monitoring Review GWMRDU, Vol. 7, No. 1, p 49-50, Winter 1987. 1 fig, 1 tab.

Descriptors: *Groundwater movement, *Path of pollutants, *Testing procedures, *Waste dumps, *Permeability coefficient, *Soil properties, Field tests, Glacial drift, Radioactive waste disposal, Soil pollution, Environmental protection.

A variety of hydraulic conductivity tests, including slug tests, pressure tests, and laboratory tests were performed at a hazardous waste site in Pennsylvania. Reasonable estimates of hydraulic conductivities were obtained, and some innovative testing methods, such as vacuum slug tests and glacial till pressure tests, were employed in the glacial drift deposits beneath the site. These methods yielded results that showed good correlation with testing methods achieved through more conventional testing methods. The equipment used for the vacuum slug test is described in the text and a diagram is included. The vacuum test method can also be applied in partially cased open boreholes. It should be noted that this method is applicable only to wells with fully submerged screens, or borings with the uncased intervals fully submerged. The testing equipment required can be modified to fit various well diameters. (Airone-PTT)
W87-06569

NATURAL ATTENUATION OF AROMATIC HYDROCARBONS IN A SHALLOW SAND AQUIFER,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 5B.
W87-06572

PRACTICAL APPLICATION OF MULTI-PHASE TRANSPORT THEORY TO GROUND WATER CONTAMINATION PROBLEMS,
EA Engineering, Science, and Technology, Inc., Lafayette, CA.
For primary bibliographic entry see Field 5B.
W87-06575

DESIGN, CONSTRUCTION AND USE OF A MECHANICALLY RECORDING WATERTABLE METER,
Ministry of Agriculture, Fisheries and Food, Cambridge (England). Field Drainage Experimental Unit.
For primary bibliographic entry see Field 7B.
W87-06593

ANALYSIS AND EVALUATION OF PUMPING TEST DATA,
International Inst. for Land Reclamation and Improvement, Wageningen (Netherlands).
For primary bibliographic entry see Field 7B.
W87-06605

2G. Water In Soils

SOIL WATER CONDITIONS AND YIELD OF TALL FESCUE, SWITCHGRASS, AND CAUCASIAN BLUESTEM IN THE APPALACHIAN NORTHEAST,
Science and Education Administration, University Park, PA. Northeast Watershed Research Center.
W. L. Stout, G. A. Jung, J. A. Shaffer, and R. Estepp.
Journal of Soil and Water Conservation JSWCA3, Vol. 41, No. 3, 184-186, May-June 1986. 6 fig, 10 ref.

Descriptors: *Soil water, *Grasses, *Crop yield, *Water stress, *Soil water availability, *Soil water yield, *Tall fescue, *Switchgrass, *Caucasian bluestem, *Appalachian Northeast, Ranching, Soil tyhpes, Productivity.

Soil conditions on beef cattle pastures in the Appalachina Northeast limit the amount of precipitation that is stored and used for forage production. To determine the effect of soil water availability on the yeild of cool- and warm-season forage grasses, four subplots each of tall fescue, switchgrass and Caucasian bluestem were established on each of two soil types (Edom silt loam and Weikert channery silt loam). Water storage capacity of the Edom profile was 16.6 cm; that of the Weikert profile was 6.25 cm. Soil water, mid-day plant water potential, and canopy temperature data were taken at two-week intervals starting at the initiation of growth in the spring and ending as each species was harvested. Productivity of switchgrass and tall fescue was significantly higher on the Edom soil than on the Weikert soil. Switchgrass produced the most dry matter and used water more efficiently than the other species. Both the cool and warm-season grasses growing on the Weikert soil experienced moisture stress at mid-day during July. Grasses growing on the Edom soil did not. Moreover, moisture stress generally was greater for the cool-season grasses than for the warm-season grasses. (Author's abstract)
W87-05966

FORMATION OF SOIL FROST AS INFLUENCED BY TILLAGE AND RESIDUE MANAGEMENT,
Agricultural Research Service, Pendleton, OR. Columbia Plateau Conservation Research Center.
For primary bibliographic entry see Field 2C.
W87-05958

BUFFERING ACID PRECIPITATES, REDUCING SOIL EROSION, AND RECLAIMING TOXIC SOIL IN THE ADVENT OF GLOBAL HUMAN CARRYING CAPACITY,
State Univ. of New York Coll. of Environmental Science and Forestry, Syracuse.
For primary bibliographic entry see Field 5G.
W87-05992

INFLUENCE OF VEGETATIVE SUCCESSION ON SOIL CHEMISTRY OF THE BERKSHIRES,
Williams Coll., Williamstown, MA.
For primary bibliographic entry see Field 5C.
W87-06076

APPLICATION OF FIELD-MEASURED SORPTIVITY FOR SIMPLIFIED INFILTRATION PREDICTION,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
S. K. Chong, and R. E. Green.
IN: Collected Reprints, Volume V: 1978-1981, June 1984. Water Resources Research Center, Honolulu, Hawaii. p 180-188, 2 fig, 1 tab, 27 ref.

Descriptors: *Sorption, *Infiltration, *Soil water, *Field tests, *Soil tests, Mathematical models, Statistical methods, On-site tests, Soil water potential. Pellicular water, Mathematical equations, So. saturation, Mathematical studies, Prediction.

The Talsma-Parlange equation, applicable for the case of immediate ponding on the soil surface, was used to predict infiltration. The sorptivity of cultivated surface soils was measured using Talsma's method. The statistical distribution of field-measured sorptivity in a large area was found to be log-normal by the Kolmogorov-Smirnov test. A linear relationship between sorptivity and soil water content was assumed for the purpose of infiltration prediction, and was obtained from the geometric mean of the field-measured sorpitivity and the sorptivity at saturation which was assumed to be zero. The method was tested on two soil series at seven soil locations, for a total of 26 infiltration measurements, including both dry and wet antecedent conditions. Predictions of cumulative infiltration were reasonably good. The present method should provide a practical means of predicting infiltration in field soils. (See also W87-06103) (Geiger-PTT)
W87-06113

PROCEEDINGS OF THE BANGKOK SYMPOSIUM ON ACID SULPHATE SOILS.
International Inst. for Land Reclamation and Improvement, Wageningen (Netherlands).
Second International Symposium on Acid Sulphate Soils, Bangkok, Thailand, January 18-24, 1981. ILRI Publication 31, 1982. 450 p. Edited by H. Dost and N. van Breeman.

Descriptors: *Soil reclamation, *Acid sulfates, *Soil-water-plant relatioahip, *Symposium, *Bangkok, *Acidic soils, Tropical regions, Asia, Africa, Soil water, Thailand, Malaysia.

The emphasis of the Symposium was on the management of soil/water/plant systems under acid sulfate soil conditions in tropical agro-ecological zones in Southeast Asia and West Africa. As such, this second symposium at Bangkok is a complementary sequel to the first symposium at Wageningen in 1972, where most of the presentations pertained to the genesis, geographical distribution, morphology, dynamics, and classification of acid sulphate soils. Many of the contributions to the Bangkok Symposium reflect the awareness of the acid sulfate soil problems in the tropical countries concerned, and that the development and implementation of effective problem-solving programs are being stimulated by cooperation among centers of advanced technology in Europe, Japan, and North America, among international organizations and institutes, and among the local universities, development agencies, experimental stations, and extension servies. The Symposium itself was instrumental in reinforcing or establishing such cooperation and contacts. (See also W87-06163 thru W87-06186) (Lantz-PTT)
W87-06162

DIRECTIONS OF FURTHER RESEARCH ON ACID SULFATE SOILS,
International Rice Research Inst., Los Banos, Laguna (Philippines).
R. Brinkman.
IN: Proceedings of the Bangkok Symposium on Acid Sulphate Soils, Second International Symposium on Acid Sulphate Soils, Bangkok, Thailand, January 18-24, 1981. ILRI Publication 31, 1982. p 12-20.

Descriptors: *Acidic soils, *Sulfates, *Acid sulfates, *Water pollution effects, *Research priorities, Toxicity, Neutralization, Soil water, Ecological effects.

Before addressing the question what kinds of research should be done on acid sulfate soils, the problems should be defined that need to be solved by this research. The acid sulfate problem comprises two main aspects: (1) the rapid formation, once or repeatedly, of acid in excess of the rapid buffering capacity of the soil to the extent that toxic conditions develop for crop plants or fish; and (2) the slow rate or high cost of the removal or the temporary or permanent neutralization of the acid. Lesser, but more persistent, problems are the potential acidity that may still be present in the subsoil and the strong phosphate fixation in the surface and subsoil of many reclaimed acid sulfate soils, which may necessitate adaptation of management practices. There is one major point of caution. As research improves the chances of success in changing the vegetation and the drainage status of large acid sulfate areas, the impact which these changes will have locally and elsewhere should be known and considered. These changes may affect the land itself, land and water downstream (including coastal waters and sea), plant and animal life locally and downstream, and the people who were living near or within the area to be developed. Both basic, supporting as well as practical, applied kinds of research are needed for the efficient use of acid sulfate soils. (See also W87-06162) (Lantz-PTT)
W87-06163

SOCIAL AND ECONOMIC ASPECTS OF THE RECLAMATION OF ACID SULFATE SOIL AREAS,
International Rice Research Inst., Los Banos, Laguna (Philippines).
R. Brinkman.
IN: Proceedings of the Bangkok Symposium on Acid Sulphate Soils, Second International Symposium on Acid Sulphate Soils, Bangkok, Thailand, January 18-24, 1981. ILRI Publication 31, 1982. p 21-36, 2 fig, 2 tab, 5 ref.

Descriptors: *Soil reclamation, *Acidic soils, *Acid sulfate soils, *Land reclamation, *Social impact, *Economic aspects, Ecological effects, Saline soils, Soil water, Public policy.

Changing an ecosystem needs to be approached with the greatest caution, to prevent social or economic damage to the families directly involved and to others nearby or elsewhere; and to prevent irreversible impoverishment of the natural diversity, which contains known and unknown resources. The distribution and extent of acid sulfate soils, and thoae in salt water and in freshwater zones, are discussed. For the saline acid sulfate soils, the main problem is the question whether or not to protect and preserve them in their natural state. For the freshwater acid sulfate soil areas, the main social and economic problem is to create an effective kind of development plan, that makes maximum use of the variability in the soils and the capabilities of the settlers, and that is designed for progresive change and improvement to correct for past mistakes. The crucial aspect in the reclamation of acid sulfate soils is mobilizing the strength of the community of people, creating the possibility for a broad base of experience. If the people moving into areas of new development are strenghthened, not weakened, in their technical abilities, their social organization and their mutual support; if they have a stake in the development of the land rather than just being planted there with government credit and fertilizers, they will not sell their borrowed ploughs and roof-sheets and go, but they will jointly make a success of the development even of acid sulfate soils. (See also W87-06162) (Lantz-PTT)
W87-06164

SOIL SURVEY OF TIDAL SULPHIDIC SOILS IN THE TROPICS: A CASE STUDY,
Land Resources Development Centre, Surbiton (England).
P. Thomas, and J. A. Varley.
IN: Proceedings of the Bangkok Symposium on Acid Sulphate Soils, Second International Symposium on Acid Sulphate Soils, Bangkok, Thailand, January 18-24, 1981. ILRI Publication 31, 1982. p 52-72, 2 fig, 2 tab, 56 ref.

Descriptors: *Soil reclamation, *Acidic soils, *Sulfides, *Tropical regions, *Path of pollutants, *Tidal lands, Soil surveys, Remote sensing, Field tests.

The need to identify and survey tidal sulfidic soils in the tropics is discussed. Various identification techniques in common use are reviewed. An account of a systematic soil survey of a tidal region in the tropics is given, and the various techniques employed are evaluated. Particularly valued techniques include remote sensing, methodical field work with pH monitoring, a soil sample bagging procedure to minimize oxidation and a shuttle system between field and laboratory ensuring the rapid transporation, or soil samples, analysis and the transfer of results to the field. The conclusion drawn is that the survey of sulfidic soils under the rigorous conditions of the tropical tidal regions holds no serious problems when a systematic approach, designed to meet the need to minimize field and laboratory work, is adopted. (See also W87-06162) (Lantz-PTT)
W87-06166

QUANTITATIVE MODELS TO PREDICT THE RATE AND SEVERITY OF ACID SULPHATE DEVELOPMENT: A CASE STUDY IN THE GAMBIA,
University of East Anglia, Norwich (England). School of Environmental Sciences.
D. L. Dent, and R. W. Raiswell.
IN: Proceedings of the Bangkok Symposium on Acid Sulphate Soils, Second International Symposium on Acid Sulphate Soils, Bangkok, Thailand, January 18-24, 1981. ILRI Publication 31, 1982. p 73-95, 8 fig, 3 tab, 7 ref.

Descriptors: *Soil reclamation, *Model studies, *Path of pollutants, *Acidic soils, *Gambia, Case studies, Sulfates, Pyrite, Diffusion, Hydrogen ion concentration.

Using a static model, the amount of acid produced following drainage of sulfidic material can be calculated from the quantity of pyrite sulfur in excess of the soil's neutralizing capacity. A dynamic model is developed in which the rate of sulfide oxidation is assumed to controlled by the rate of diffusion of oxygen through water-filled pore space. The rate of acid production is then determined by (1) the excess pyrite S content of the material, and (2) its surface to volume ratio - in effect soil structure. Following drainage, unripe soils fissure into coarse prisms of radius less than length. This structure can be modeled approximately by solving equations for the diffusion of oxygen into cylinders. Both pyrite S and soil structure development occur naturally over a range of values that significantly affects the rate of acid generation. Tables are presented showing the influence of S content and ped size on acid production. The model is applied to the potential acid sulfate soils of the Gambia. Severe acidity is predicted to develop rapidly if the water table is lowered. The actual pH values of the soil and river water will depend on the drainage regime and the effectiveness of flushing of acid fromm the soil to the drainage water. (See also W87-06162) (Lantz-PTT)
W87-06167

PROBLEMS OF CLASSIFYING SOILS WITH SULFIDIC HORIZONS IN PENINSULAR MALAYSIA,
Malaysian Agricultural Research and Development Inst., Serdang.
S. Paramananthan, and B. Gopinathan.
IN: Proceedings of the Bangkok Symposium on Acid Sulphate Soils, Second International Symposium on Acid Sulphate Soils, Bangkok, Thailand, January 18-24, 1981. ILRI Publication 31, 1982. p 96-102, 2 fig, 8 ref.

Descriptors: *Soil reclamation, *Soil classification, *Sulfates, *Acidic soils, *Malaysia, *Water pollution effects, Soil water, Drainage, Marine alluvium, Brackish water, Soil horizons.

An acid sulfate soil sequence developed on coastal clay soils in Peninsular Malaysia is described. Soil ripening after the construction of bunds and drains has resulted in the development of sulfuric and cambic horizons. The underlying material is commonly sulfidic. Two similar sequences are recognized, one on marine alluvium, and the other on brackish water deposits. The brackish water deposits are characterized by higher organic matter content. The problems associated with mapping and classification are noted, and changes in the Soil Taxonomy to cater for the anomalies are proposed. (See also W87-06162) (Lantz-PTT)
W87-06168

ACID SULPHATE SOILS OF THE MANGROVE AREA OF SENEGAL AND GAMBIA,
Office de la Recherche Scientifique et Technique Outre-Mer, Paris (France).
For primary bibliographic entry see Field 2L.
W87-06169

CHEMICAL CHARACTERISTICS AND FERTILITY STATUS OF ACID SULPHATE SOILS OF THAILAND,
Kasetsart Univ., Bangkok (Thailand). Dept. of Soils.
For primary bibliographic entry see Field 5C.
W87-06170

EFFECTS OF LIMING AND FERTILIZER APPLICATIONS TO ACID SULFATE SOILS FOR IMPROVEMENT OF RICE PRODUCTION IN THAILAND,
Ministry of Agriculture and Cooperatives, Bangkok (Thailand). Dept. of Land Development.
For primary bibliographic entry see Field 5G.
W87-06171

STUDY ON RATES OF MARL FOR RICE PRODUCTION ON ACID SULPHATE SOILS IN THAILAND,
Ministry of Agriculture and Cooperatives, Bangkok (Thailand). Dept. of Land Development.
For primary bibliographic entry see Field 5G.
W87-06172

ROCK PHOSPHATE IN RICE PRODUCTION ON ACID SULPHATE SOILS IN VIETNAM,
Can Tho Coll. (Vietnam). Faculty of Agriculture.
For primary bibliographic entry see Field 5G.
W87-06173

MANAGEMENT OF ACID SULPHATE SOILS IN THE MUDA IRRIGATION SCHEME, KEDAH, PENINSULAR MALAYSIA,
Malaysian Agricultural Research and Development Inst., Serdang. Rice Research Branch.
For primary bibliographic entry see Field 5G.
W87-06174

FIELD AMELIORATION OF AN ACID SULFATE SOIL FOR RICE WITH MANGANESE DIOXIDE AND LIME,
International Rice Research Inst., Los Banos, Laguna (Philippines).
For primary bibliographic entry see Field 5G.
W87-06175

IMPROVEMENT OF ACID SULFATE SOILS: EFFECTS OF LIME, WOOD ASH, GREEN MANURE AND PREFLOODING,
Djibelor Rice Research Station, Sefa (Senegal).
For primary bibliographic entry see Field 5G.
W87-06176

EFFECTS OF LIME AND PHOSPHORUS ON THE GROWTH AND YIELD OF RICE IN ACID SULPHATE SOILS OF THE CASAMANCE (SENEGAL),
Djibelor Rice Research Station, Sefa (Senegal).
For primary bibliographic entry see Field 5G.
W87-06177

RICE CULTIVATION ON ACID SULPHATE SOILS IN THE VIETNAMESE MEKONG DELTA,
Can Tho Coll. (Vietnam).
For primary bibliographic entry see Field 5G.
W87-06178

EFFECT OF WATER MANAGEMENT ON FIELD PERFORMANCE OF OIL PALMS ON ACID SULPHATE SOILS IN PENINSULAR MALAYSIA,
Harrisons and Crosfield (Malaysia), Kuala Lumpur.
For primary bibliographic entry see Field 5G.
W87-06179

PROBLEMS IN RECLAIMING AND MANAGING TIDAL LANDS OF SUMATRA AND KALIMANTAN, INDONESIA,
Euroconsult, Arnhem (Netherlands).
For primary bibliographic entry see Field 5G.
W87-06180

VARIETAL REACTIONS OF RICE TO IRON TOXICITY ON AN ACID SULFATE SOIL,
International Rice Research Inst., Los Banos, Laguna (Philippines).
For primary bibliographic entry see Field 5C.
W87-06181

WATER, SOIL AND RICE IN AN ACID SULFATE SOIL OF THAILAND,
Tokyo Univ. (Japan). Faculty of Agriculture.
H. Wada, J. Chunchareonsook, S. Panichsakpatana, P. Prabuddham, and T. Attanandana.
IN: Proceedings of the Bangkok Symposium on Acid Sulphate Soils, Second International Symposium on Acid Sulphate Soils, Bangkok, Thailand, January 18-24, 1981. ILRI Publication 31, 1982. p 302-317, 5 fig, 3 tab, 7 ref.

Descriptors: *Soil-water-plant relationships, *Soil water, *Acidic soils, *Path of pollutants, *Rice, Sulfates, Chlorides, Sodium, Magnesium, Ammonia, Iron, Runoff, Vertical distribution, Vertical flow, Nitrogen.

Four long-term experimental plots at the Rangsit Rice Experimental Station (Rangsit series) were selected as the sites of investigation. Vertical flow of water and leaching loss of water soluble substances should be minimum in this soil during most periods of submergence since internal drainage of the soil is extremely poor and the groundwater table is high. Flood water became acidified and enriched with SO4(2-), Cl(-), Na(+), Mg(2+), from the soil, indicating that substances accumulated in the submerged soil tend to diffuse upward and to be transferred to the flood water. At the soil-water interface a very thin and acid oxidized layer is formed that might partly inhibit nitrification-denitrification processes in the topsoil. The vertical profile of Fe(2+) and NH4(+) in the Apg horizon support the supposition of upward diffusion of these substances. Removal of NH4(+) in flood runoff is proposed as one of the main processes of N-loss from the acid sulfate soil. N2-fixing activity was low in the early stage, became very high at the flowering stage and low again at harvesting time. The decrease in the N2-fixing activity in the later period may have been caused by a decrease in the population of active microorganisms. Nitrogen absorbed by rice plants is found to be nearly equal to the amount of 'utilizable N in soil' which can be calculated from the NH4(+) content in the soil. (See also W87-06162) (Lantz-PTT)
W87-06182

RAPID RECLAMATION OF BRACKISH WATER FISHPONDS IN ACID SULFATE SOILS,
International Rice Research Inst., Los Banos, Laguna (Philippines).
For primary bibliographic entry see Field 5G.
W87-06183

MANAGEMENT OF ACID SULFATE SOILS FOR BRACKISH WATER FISHPONDS: EXPERIENCE IN THE PHILIPPINES,
Brackish Water Aquaculture Center, Leganes, Iloilo (Philippines).
For primary bibliographic entry see Field 5G.
W87-06184

PHOSPHATE DYNAMICS IN AN ACID SULFATE SOIL UNDER FLOODED CONDITION STUDIED BY A TRACER TECHNIQUE,
Royal Statistical Society, London (England).
For primary bibliographic entry see Field 5B.
W87-06185

SIMPLE, LOW-COST METHOD TO COLLECT UNDISTURBED CORES OF ACID SULFATE SOIL PROFILES FOR THE STUDY OF WATER AND SOLUTE MOVEMENT DURING RECLAMATION AND USE FOR WETLAND RICE,
International Rice Research Inst., Los Banos, Laguna (Philippines).
For primary bibliographic entry see Field 7B.
W87-06186

ELEMENTS OF SOIL SCIENCE AND GROUNDWATER HYDROLOGY,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 2F.
W87-06203

MICROBIAL POLLUTANTS: THEIR SURVIVAL AND TRANSPORT PATTERN TO GROUNDWATER,
Arizona Univ., Tucson. Dept. of Microbiology and Immunology.
For primary bibliographic entry see Field 5B.
W87-06205

MICROBIOLOGICAL PROCESSES AFFECTING CHEMICAL TRANSFORMATIONS IN GROUNDWATER,
Stanford Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2K.
W87-06206

ACID SULPHATE SOILS: A BASELINE FOR RESEARCH AND DEVELOPMENT,
International Inst. for Land Reclamation and Improvement, Wageningen (Netherlands).
For primary bibliographic entry see Field 5B.
W87-06233

COMPARISON OF PESTICIDE ROOT ZONE MODEL PREDICTIONS WITH OBSERVED CONCENTRATIONS FOR THE TOBACCO PESTICIDE METALAXYL IN UNSATURATED ZONE SOILS,
Environmental Research Lab., Athens, GA.
For primary bibliographic entry see Field 5B.
W87-06311

UNSATURATED ZONE STUDIES OF THE DEGRADATION AND MOVEMENT OF ALDICARB AND ALDOXYCARB RESIDUES,
Union Carbide Agricultural Products Co., Inc., Research Triangle Park, NC.
For primary bibliographic entry see Field 5B.
W87-06312

SPATIAL VARIABILITY OF WATER MOVEMENT IN SOIL: USE OF A TRACER AND GEOSTATISTICAL ANALYSIS (VARIABILITIE SPATIALE DU TRANSFERT DE L'EAU DANS LE SOL: UTILISATION DU TRACAGE ET ANALYSE GEOSTATISTIQUE),
Avondale Coll. of Advanced Education, Cooranbong (Australia). Dept. of Science.
C. Gascuel-Odoux, and P. Merot.
Journal of Hydrology JHYDA7, Vol. 89, No. 1/2, p 93-107, December, 1986. 8 fig, 1 tab, 36 ref.

Descriptors: *Soil water movement, *Tracers, *Groundwater movement, *Oxygen-18, *Isotopic tracers, *Soil water, *Mathematical models, Multibox model, Statistics, Seasonal variation, Variation coefficient, Elution curves, Geostatistics, Kriging, Dispersion.

Water movement was studied in the field using the varying concentrations of oxygen-18 in winter precipitation as a tracer peak, which was used to observe the characteristics of water displacement during this period. The soil moisture response to this tracer was analyzed at 34 sties over a 2.5-ha parcel where isotopic profiles are studied. The depth and range of the peak at each site, which respectively take into account the effective velocity of water movement and a parameter of soil dispersivity, were analyzed with a one-dimensional multibox model. Geostatistics was employed to study the spatial variability of water movement in the study area. A mean value of the effective velocity and the elution curve of the tracer could be calculated, as well as their coefficients of variation and their structures, which depend on the covariance function between the sampling points. This result also was used to map the two parameters by kriging and to analyze the spatial variation. The vertical water movement averaged 10 to the minus 8th power m/sec and was not very dispersive. The spatial variability was weak, with a 30% coefficient of variation. The effective velocity was randomly distributed on the parcel, whereas the dispersion was structured. This clear trend had not been shown by the soil survey. (Author's abstract)
W87-06381

SURFACE CHARGE CHARACTERISTICS AND LIME REQUIREMENTS OF SOILS DERIVED FROM BASALTIC, GRANITIC, AND METAMORPHIC ROCKS IN HIGH-RAINFALL TROPICAL QUEENSLAND,
Commonwealth Scientific and Industrial Research Organization, Townsville (Australia). Div. of Soils.
G. P. Gillman, and E. A. Sumpter.
Australian Journal of Soil Research ASORAB, Vol. 24, No. 2, p 173-192, 1986. 5 fig, 8 tab, 20 ref, append.

Descriptors: *Soil chemistry, *Soil types, *Cation exchange, *Anion exchange, *Igneous rocks, *Metamorphic rocks, *Rainfall, Australia, Weathering, Hydrogen ion concentration, Tropical regions, Metals.

The cation and anion exchange capacities (CEC and AEC, respectively) were examined in a large number of soils formed on basaltic, granitic, and metamorphic parent materials in the high rainfall area (approximately 4000 mm) of tropical north Queensland (Australia). The changes in CEC and AEC between pH 4 and 6, the relative amounts of permanent and variable charge of this pH range, and the lime requirements of these highly weathered soils were studied. At low pH, the basic CEC (CEC sub B, which is the Ca adsorbed) may be much less than the total CEC (CEC sub T). The CEC sub B increase with pH in the highly oxidic basaltic soils is due largely to changes in surface charge, whereas in the granitic and metamorphic soils, increasing occupation of exchange sites by Al as pH decreases is the factor responsible for the increase in CEC sub B. A good estimation of CEC sub B at soil pH is obtained with a previously described compulsive exchange method, and there is a high correlation between CEC sub T at soil pH and the effective CEC (= Ca + Mg + K + Na + Al). The amount of lime required to raise soil pH to about 5.5 in the granitic and metamorphic soils was equivalent to the amount of exchangeable Al, but in the basaltic soils the lime requirement was two to three times greater than the amount of exchangeable Al. (Author's abstract)
W87-06387

SPRINGTIME EVAPORATION FROM BARE AND STUBBLE-COVERED SOIL,
North Dakota State Univ., Fargo. Dept. of Soil Science.
For primary bibliographic entry see Field 2D.
W87-06400

INFLUENCE OF SOIL WATER STATUS ON THE EPIDEMIOLOGY OF TOBACCO BLACK SHANK,
Florida Univ., Gainesville. Dept. of Plant Pathology.
D. M. Ferrin, and D. J. Mitchell.
Phytopathology PHYTAJ, Vol. 76, No. 11, p 1213-1217, November 1986. 4 fig, 1 tab, 20 ref.

Descriptors: *Soil water, *Plant diseases, *Plant pathology, *Plant growth, Plant populations, *Tobacco, *Mortality, Flowering, Inoculum, Parasites, Resistance, Cultivars.

The relationship of soil water status to the rate of increase in mortality of tobacco in a field infested with Phytophthora parasitica var. nicotiana was examined. Multiple cycles in the increase in mortality occurred in the susceptible cultivar, Hicks. Generally only a single cycle in the increase in mortality occurred in the resistant cultivar, Speight G-28; this was attributed to the delay of appreciable mortality until after flowering, which limited time for secondary cycles. Increases in the average rates of change in mortality were negatively cross correlated with increases in the average rates of soil water status for both cultivars. These increases differed between cultivars in both their magnitude and the times of the initial and maximum responses. Ordinary run analysis was conducted over time to ascertain the temporal pattern of the random or nonrandom occurrence of plant mortality. Increases in the percentages of plots with a nonrandom occurrence of plant mortality coincided with periods of increased soil moisture. Evidence for the increase or spread of inoculum was more pronounced in the susceptible than in the resistant cultivar as demonstrated by the eventual near uniformity of mortality throughout plots of Hicks compared with plots of Speight G-28. (Author's abstract)
W87-06405

SOIL MOISTURE FLOW IN DRAINAGE-SUBIRRIGATION SYSTEM,
University Coll., Dublin (Ireland). Dept. of Civil Engineering.
T. Brandyk, and J. G. Wesseling.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 113, No. 1, p 86-97, February 1987. 10 fig, 31 ref.

Descriptors: *Soil water, *Model studies, *Soil profiles, *Drainage, *Water management, Water boundary, Boundary conditions, Calculations, Drainage ditches, Drainage effects, Drainage, Subsurface water, Mathematical equations, Mathematical models, Mathematical studies, Unsaturated flow, Profiles, Flow, Field tests, Water level, Moisture content, Irrigation.

Results of calculations performed with a numerical model for unsaturated soil moisture flow were presented. The possibility of using different boundary conditions to obtain the daily moisture content of a soil profile located in the middle between two drainage ditches was demonstrated. Results obtained with the numerical model generally show good agreement with measured field data. After determining only a few standard soil, plant, and meteorological parameters, it is possible to describe the changes in the moisture content of the soil profile during growing season. Application of the model makes optimum water management in drainage-subirrigation systems possible by controlling the water level in the ditches. (Author's abstract)
W87-06415

SOIL WATER STATUS AFFECTS THE STOMATAL CONDUCTANCE OF FULLY TURGID WHEAT AND SUNFLOWER LEAVES,

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.
For primary bibliographic entry see Field 2I.
W87-06530

NATURAL ATTENUATION OF AROMATIC HYDROCARBONS IN A SHALLOW SAND AQUIFER,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 5B.
W87-06572

PROCEEDINGS OF THE SYMPOSIUM ON PEAT LANDS BELOW SEA LEVEL.
International Inst. for Land Reclamation and Improvement, Wageningen (Netherlands).
For primary bibliographic entry see Field 2H.
W87-06622

SOILS AND THEIR GEOGRAPHY,
Stichting voor Bodemkartering, Wageningen (Netherlands).
H. de Bakker.
IN: Proceedings of the Symposium on Peat Lands Below Sea Level, August 24-28, 1981, The Netherlands. IRLI Publication No. 30, 1982. p 85-97, 4 fig, 2 tab, 10 ref.

Descriptors: *Geography, *The Netherlands, *Peat Soils, *Soil types, *Peat bogs, Sand, Clays, Soil profiles, Loam, Land reclamation, Marine sediments, Muck soils, Calcareous soils, Manure, Surface drainage, Topsoil, Subsoil, Land use, Horticulture, Dunes, Soil surveys, Fluvial sediments, Podzols.

The patterns and geography of soils found in the western part of the Netherlands are described. The Pleistocene deposits (all sands) in the east dip below the Holocene deposits at about sea level, slope gently to the west, and pass the coast at about 18 m below sea level. The soils are podzols used mostly as pine forest, arable land, and grasslands. The coastal dune area consists of humus-poor sands used for bulb-growing and dairying. The estuarine soils situated around Leiden are dune sand mixed with mud and manure. They are used for grasslands, arable land, and horticulture. The riverine soils are silty clays overlying woody peat. They are used for dairying, horticulture, and orchards. Much of the peat lands and drained bog floors have urban development. In the non-excavated peat lands, the remaining peat is clayey wood peat and an earthy wood peat containing mixtures of sand from the excavated dunes, mud and manure. This area is used for grasslands for dairying and for horticulture. The reclaimed bog floors contain mineral soils developed in Calais deposits, with a dark humose topsoil, an acid sulfate middle soil, and a mineral subsoil. A deeper subsoil is an acid layer called cat-clay. The non-acid soils are partly calcareous. These soils are all tile-drained and excellently suited for growing a wide range of crops, grasses and horticultural species. (See also W87-06622) (Geiger-PTT)
W87-06627

DRAINAGE AND BEHAVIOUR OF PEAT SOILS,
Instituut voor Cultuurtechniek en Waterhuishouding, Wageningen (Netherlands).
For primary bibliographic entry see Field 4A.
W87-06630

USE OF PEAT AND PEAT SOILS FOR HORTICULTURE,
Advisory Service for Soils and Fertilizers in Horticulture, Wageningen (Netherlands).
For primary bibliographic entry see Field 2I.
W87-06634

MAIN PROPERTIES OF HORTICULTURAL PEAT,
Peat Research Inst., Helsinki (Finland).
V. Puustjarvi.
IN: Proceedings of the Symposium on Peat Lands Below Sea Level, August 24-28, 1981, The Netherlands. IRLI Publication No. 30, 1982. p 260-266, 4 tab.

Descriptors: *Soil properties, *Peat soils, *Horticulture, *Peat, *Soil science, Soil water, Soil porosity, Soil structure, Soil texture, Organic soils, Growth media, Soil water potential, Mosses, Soil analysis, Sieve analysis, Soil classification, Soil-water-plant relationships.

The nutrient storage capacity of peat varies according to its botanical composition and degree of decomposition. An ideal growing medium must have a pore space that is large and divided about equally to water and air spaces. Sphagnum mosses are capable of retaining large quantities of water, the amount varying according to species. The sieve analysis and air capacity methods of measuring peat structure were compared in 200 samples of industrially produced light Sphagnum moss peat. Peat samples were divided by visual inspection into two groups, i.e. extremely pure Sphagnum moss peat and peat containing small quantities of cotton grass and subshrub residues. Results indicated that the particle size distribution and the air capacity of pure Sphagnum moss peat are clearly dependent on each other. Fractions of both 1 mm and 8 mm can be used for indicating the particle size distribution. The particle size distribution and the air capacity of peat containing subshrub and cotton grass residues seem to be independent of each other. The deviations in particle size distribution and air capacity were attributed mainly to the non-uniform structure of the peat mixed with residues of other plants, and the lack of lignins (humic acid precursors) in pure peat moss which change the water retention properties and compress peat by glueing small particles to each other. Since small residues of other plants change the properties of peat in decisive ways, the Peat Research Institute recommends that a Class I analysis of Sphagnum moss peat include the following: proportion of subshrub residues not more than 3% w/w, proportion of cotton grass and sedge residues not more than 6% w/w, and proportion of Sphagnum moss residues not less than 90%. (See also W87-06622) (Geiger-PTT)
W87-06635

FUNDAMENTALS OF THE THEORY OF PEAT DEPOSIT DRAINING,
All-Union Scientific Research Inst. for the Peat Industry, Leningrad (USSR).
S. S. Korchunov.
IN: Proceedings of the Symposium on Peat Lands Below Sea Level, August 24-28, 1981, The Netherlands. IRLI Publication No. 30, 1982. p 267-271.

Descriptors: *Peat soils, *Surface drainage, *Soil water potential, *Water table, *Soil moisture retention, Soil water, Soil porosity, Moisture tension, Moisture content, Soil properties, Peat, Peat bogs, Drainage practices, Drainage programs.

The principal problem of peat deposit draining is the creation of favorable conditions for its further utilization. The drainage rate, an average depth of groundwater-level over a long period, is best evaluated by the moisture potential (tension in water) in the layer. The value of the moisutre potential includes the influence of the depth above the groundwater-level, as well as, the meteorological conditions of the preceding period, taking into account the water-physical properties of the peat deposit. For the upper layers of a deposit to be drained, it takes an average of 2 to 4 yr for low-moor peats possessing a good filterability and of 4 to 6 yr for peats of the high-moor type; the duration of the draining process in the deep-lying bottom layers of thick high-moor deposits is about 10-20 yr. The movement of moisture in the deeper layers can be considered a stationary process to simplify theorical methods of calculation. Below the groundwater-level, the stationary moisture movement can be described according to Darcy's law. Above the groundwater-level the distribution of the moisture potential or moisture content can be determined by computing a differential equation of the moisture potential. In well drained peat deposits with a groundwater-level 1 m or more below the surface, depression of the moisture potential occurs. Depression of the potential can be reduced by increasing the coefficient of moisture conductivity with artificial measures or by preventing the entry of moisture from precipitation into the depth of the deposit. Many laboratory methods for determining the moisture coefficient exist; the use of a constant flow of moisture over the surface of a sample is the most effective one. The drainage of peat deposits with strong seepage is difficult. To handle this problem the All-Union Scientific Research Institute for Peat Industry has tried transporting peat from deposits to well drained fields for drying. The excavation of deposits under water is performed by a multibucket floating excavator. (See also W87-06622) (Geiger-PTT)
W87-06636

VEGETATIONAL DEVELOPMENT OF A WOOD PEAT DEPOSIT, AS READ FROM ITS POLLEN CONTENT,
Agricultural Univ., Wageningen (Netherlands).
For primary bibliographic entry see Field 2I.
W87-06637

2H. Lakes

AQUATIC ECOSYSTEM IDENTIFICATION USING THE GROUP METHOD OF DATA HANDLING,
Ecole Nationale Superieure d'Ingenieurs Electriciens de Grenoble, Saint-Martin d'Heres (France). Lab. d'Automatique.
A. Serrano, and S. Gentil.
Environmental Technology Letters ETLEDB, Vol. 6, No. 12, p 517-525, December 1985. 5 fig, 8 ref.

Descriptors: *Data interpretation, *Ecosystems, *Mathematical models, *Prediction, *Aquatic ecosystems, Group Method of Data Handling, France, Simulation models.

The original Group Method of Data Handling (GMDH), which is based on an algorithm of Ivakhnenko, and the revised version by Tamura and Kondo were applied to data collected in an aquatic ecosystem (Lake Aiguebelette, France). The revised method of Tamura and Kondo seems to be good for constructing predictive or descriptive models, but not for structural analysis. The simulation models obtained with the GMDH approach are better than those based on linear techniques, but it is difficult to say how much confidence can be attached to long-term predictions made with a model the structure of which does not seem to agree with the a priori knowledge of the system. (Rochester-PTT)
W87-05928

DETERMINISTIC MODEL FOR FORECASTING LAND PLANNING EFFECTS ON A LAKE ECOSYSTEM,
Pavia Univ. (Italy). Dipt. di Idraulica e Disinquinamento.
V. Vendegna, and S. Teruggi.
Environmental Technology Letters ETLEDB, Vol. 6, No. 12, p 526-535, December 1985. 2 fig, 2 tab, 20 ref.

Descriptors: *Model studies, *Aquatic ecosystems, *Limnology, *Limiting nutrients, *Primary productivity, *Lakes, Phytoplankton, Zooplankton, Organic matter, Light, Bacteria, Temperature, Italy, Simulation, Kinetics, Epilimnion, Algae.

An ecological model is outlined that allows simulation of the kinetic ratio existing between limiting nutrients, primary production, consumption, and decomposition in a lake's epilimnion. The model aims to evaluate the development of phytoplanktonic algae, of herbivorous zooplankton, and bacterial flora according to organic matter, nutrients, light, and temperature, and the effect of the biotic community on the nutrient concentration, dissolved and particulate organic matter, and water transparency. An example of the calculation of the model is carried out for a typical northern Italian lake of medium depth to show the effect of differ-

ent wastewater treatment projects on the lake ecosystem. (Author's abstract)
W87-05929

IMPACT OF HYPOLIMNETIC AERATION ON ZOOPLANKTON AND PHYTOPLANKTON POPULATIONS,
York Univ., Downsview (Ontario). Dept. of Biology.
D. J. McQueen, and V. A. Story.
Environmental Technology Letters ETLEDB, Vol. 7, No. 1, p 31-44, January 1986. 13 fig, 7 tab, 33 ref.

Descriptors: *Water pollution treatment, *Limnology, *Lakes, *Eutrophication, *Hypolimnion, *Aeration, *Zooplankton, *Phytoplankton, *Algal control, Chlorophyll a, Succession, Canada, Lake St. George.

The biological impact of hypolimnetic aeration was assessed using large, paired enclosures in Lake St. George (Canada). During the spring, chlorophyll a concentrations and phytoplankton cell counts were much lower in the aerated enclosure than they were in the non-aerated experiment. During the summer, cell counts and biomasses were similar in both. The aerated and non-aerated enclosures showed no major differences in zooplankton distributions, species composition, or successional patterns. It is concluded that hypolimnetic aeration can reduce the intensity of spring algal blooms without posing and environmental threat to phytoplankton and zooplankton populations. (Author's abstract)
W87-05938

MUSTY ODOR FROM BLUE-GREEN ALGA, PHORMIDIUM TENUE IN LAKE KASUMIGAURA,
National Inst. for Environmental Studies, Tsukuba (Japan).
For primary bibliographic entry see Field 5B.
W87-05941

WETLAND RESTORATION: A PILOT PROJECT,
Fish and Wildlife Service, Fergus Falls, MN.
C. Madsen.
Journal of Soil and Water Conservation JSWCA3, Vol. 41, No. 3, 159-160, May-June 1986. 6 ref.

Descriptors: *Wetlands, *Ashby, *Wetlands reclamation, *Public participation, Minnesota, Land use, Water conservation, Wildlife conversation, Agriculture, Government agencies, Drainage, Dams, Drain tiles, Ditches, Wildlife management, Ducks.

Most wetland losses are due to agricultural development. Many states and the federal government, are engaged in wetland preservation efforts. Any drained wetland can be restored. A recent example of private wetland restoration occurred near Ashby, Minnesota. Fish and Wildlife Service personnel designed a dam to restore the wetland and local sporting clubs paid for its construction. The three critical elements needed for successful wetland restoration are: a willing landowner, available construction funds, and a public agency to provide technical guidance and coordinate construction activities. A goal of 2,000 acres of wetlands was established for restoration in this trial. Land owners signed a 10-year lease for use of the land. They were offered three options for upland cover in their wetland contracts: nonuse grass, delayed harvest of alfalfa, and no-till small grain. Development costs were paid for by two state agencies, a national organization and a sporting club. Early indications are that the areas are at least as good as naturally occurring wetlands. (Main-PTT)
W87-05962

SUCCESSION THEORY, EUTROPHICATION, AND WATER QUALITY MANAGEMENT,
Loyola Univ. of Chicago, IL. Dept. of Natural Science.
D. B. Rosenberg, and S. M. Freedman.
International Journal of Environmental Studies IJEVAW, Vol. 28, No. 2/3, p 109-121, 1986. 3 fig, 43 ref.

Descriptors: *Succession, *Eutrophication, *Water quality management, *Environmental control, *Nuisance algae, Cyanophyta, Nutrients, Ecology, Algae, Density, Population density, Temperature, Hydrogen ion concentration, Carbon dioxide, Physical properties, Aquatic life, Plankton, Phytoplankton, Fish, Predation, Biomass.

The application of ecological succession theory to the regulation of eutrophication offers a unique biological approach to water quality management. Eutrophication is examined on the basis of five trends associated with succession theory. It is demonstrated that the rate and sequence of succession can be managed so that the dominance of a specific population is regulated, and it is proposed that if the successional sequence is manipulated, a redistribution of energy, nutrients, and biomass can occur. Several examples are discussed of how succession theory can be applied to control blue-green algae populations. Information from current field studies is presented to show that a successional sequence leading to blue-green dominance is less likely to occur by reducing or manipulating herbivore populations, decreasing secondary carnivores (planktivorous fish), increasing keystone carnivores (piscivores), or increasing specific detrivores. (Author's abstract)
W87-05994

ENERGY SOURCES FOR DETRITIVOROUS FISHES IN THE AMAZON,
Instituto Nacional de Pesquisas da Amazonia, Manaus (Brazil).
C. A. R. M. Araujo-Lima, B. R. Forsberg, R. Victoria, and L. Martinelli.
Science SCIEAS, Vol. 234, No. 4781, p 1256-1258, December 5, 1986. 2 fig, 17 ref. NSF Grant DEB 81-07522 and Sudam, Polamazonia and International Atomic Energy Agency Grant Amazonia I/BRA/0/010.

Descriptors: *Energy sources, *Fish diets, *Amazon basin, *Catfish, *Food chains, *Diets, Ecology, Phytoplankton, Fish, Aquatic plants, Plankton, Proteins, Nutrition, Food habits, Tracers, Isotopic tracers.

Effective management of detritivorous fishes in the Amazon basin requires an understanding of factors controlling their production. A stable isotope tracer study of carbon flow through fish food chains was undertaken to identify the principal autotrophic carbon sources supporting detritivorous fish production in the Amazon. It was found that catfishes could be receiving carbon primarily from periphyton or from an unknown mixture of plant end members; it is concluded that neither phytoplankton nor C4 macrophytes provide all the energy for this group. On the other hand, the Characiformes must receive a large fraction of their carbon from phytoplankton and very little from other plant groups. Results suggest that a large proportion of the fish consumed in the Amazon is derived through food chains beginning with phytoplankton. Macrophytes, which have been proposed as a major energy source for detritus-based food chains, appear to be relatively unimportant. (Doria-PTT)
W87-06017

ARSENIC, ANTIMONY AND SELENIUM SPECIATION DURING A SPRING PHYTOPLANKTON BLOOM IN A CLOSED EXPERIMENTAL ECOSYSTEM,
Southampton Univ. (England). Dept. of Chemistry.
For primary bibliographic entry see Field 2K.
W87-06063

CHEMICAL PROCESSES IN LAKES.
John Wiley and Sons, New York, New York. 1985. 435 p. Edited by Werner Stumm.

Descriptors: *Lake morphology, *Chemical processes, Chemical properties, Kinetics, Model studies, Lake sediments, Eutrophication, Water pollution effects, Environmental impact, Limnology, Ecosystem.

This account of current research on chemical processes in lakes emphasizes those processes that regulate the distribution of elements and compounds, utilizing kinetic information wherever possible and often using steady-state and dynamic models. Special attention is given to the solid-solution interface and to an assessment of the dominant roles of settling particles and the sediment-water interface in regulating concentrations of heavy metals and other reactive substances. An attempt is made to show how the lacustrine ecosystem responds to human impact, especially to stresses resulting from chemical perturbation. Measures for restoring eutrophied lakes are included. Although the nonbiological side of limnology is emphasized, lakes must be viewed and studied as microcosms. Therefore, the common goal of many of the authors is to determine both how the chemical environment interacts with organisms and ecosystems and to assess how they relate to one another. (See also W87-06127) (Lantz-PTT)
W87-06126

SPATIAL AND TEMPORAL DISTRIBUTION OF CHEMICAL SUBSTANCES IN LAKES: MODELING CONCEPTS,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
For primary bibliographic entry see Field 5B.
W87-06127

CONCEPTUAL MODELS FOR TRANSPORT AT A REDOX BOUNDARY,
Freshwater Biological Association, Ambleside (England).
For primary bibliographic entry see Field 2K.
W87-06128

CARBON ISOTOPES AND PRODUCTIVITY IN THE LACUSTRINE AND MARINE ENVIRONMENT,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Geologisches Inst.
J. A. McKenzie.
IN: Chemical Processes in Lakes, John Wiley and Sons, New York, New York. 1985. p 99-118, 11 fig, 25 ref.

Descriptors: *Carbon, *Chemical processes, *Limnology, *Productivity, *Marine environment, Photosynthesis, Respiration, Surface water, Carbonates, Calcium carbonate, Organic matter, Lake sediments, Marine sediments.

The carbon-isotope composition of the dissolved inorganic carbon in lacustrine and marine waters is primarily controlled by the photosynthesis-respiration cycle. Carbon-12 is essentially transferred from the surface waters to the deeper waters by a photosynthesis-respiration pathway. Photosynthetically produced organic matter is enriched in carbon-12, and as it sinks, it is oxidized, releasing carbon-12 enriched CO2 to underlying waters. This isotope fractionation produces a similar delta-13-C profile in both lakes and oceans. The delta-13-C values of the surface waters are more positive, while the values of intermediate to deep waters are relatively more negative. As carbonate precipitates are basically in isotopic equilibrium with the dissolved inorganic carbon, calcium carbonate (which is precipitated in situ within the water column either as a biogenically induced precipitate or the test (hard part) of a microorganism) contains a carbon-isotope composition characteristic of the water depth. Significant changes in the rate of surface-water productivitiy are reflected by fluctuations in the delta-13-C values incorporated into the surface-water carbonates. For example, an increased nutrient supply to an aquatic basin promotes increased productivitiy and more and more carbon-12 is removed from the surface waters by the sinking organic matter, which may be subsequently buried as the oxygen of the bottom waters becomes depleted. Simultaneously, the delta-13-C value of the surface-water carbonates tends toward

more and more positive values. Carbon-isotope stratigraphy in lacustrine and marine sediments is therefore a measure of the paleoproductivity of the basin. (See also W87-06126) (Author's abstract)
W87-06131

REDOX-RELATED GEOCHEMISTRY IN LAKES: ALKALI METALS, ALKALINE-EARTH ELEMENTS, AND 137-CS,
Woods Hole Oceanographic Institution, MA.
E. R. Sholkovitz.
IN: Chemical Processes in Lakes, John Wiley and Sons, New York, New York. 1985. p 119-142, 8 fig, 1 tab, 10 ref. DOE Contract No. DE-AC02-83ER60172.

Descriptors: *Oxidation-reduction potential, *Limnology, *Geochemistry, *Alkali metals, *Cesium, *Alkaline earth metals, *Path of pollutants, Sodium, Potassium, Magnesium, Calcium, Barium, Iron, Lake sediments.

Redox-driven reactions are important components of the biogeochemical cycles in many lake waters and sediments. The possible coupling between redox conditions and the aquatic chemistry of alkali metals (Na, K, Cs), alkaline-earth elements (Mg, Ca, Ba), and radioactive 137-Cs is discussed. Water column (dissolved and suspended particulate phases) and pore water data are used to show that anoxic conditions indirectly result in enhanced fluxes of alkali and alkaline-earth elements across the sediment-water interface. An important reaction appears to be the release of these elements from an adsorbed phase as the reduction of sedimentary (Fe(III) oxides yields the more soluble Fe(II) species under anoxic conditions in lakes. As such, the alkali and alkaline-earth elements undergo a seasonal cycle in the hypolimnion of seasonally anoxic lakes. Recent studies in lakes are used to hypothesize that anoxic conditions in certain types of lake sediments may result in enhanced mobilities of 137-Cs across the sediment-water interface and within the sediment column. The indirect coupling between ammonia production, which accompanies anoxic conditions, and the exchange of ammonium cations for 137-Cs may be an important process in sediments of certain mineralogical compositions. Before any generalities about 137-Cs mobility can be made, much more data on 137-Cs in anoxic sediments and water columns are required. (See also W87-06126) (Author's abstract)
W87-06132

MECHANISMS CONTROLLING THE SEDIMENTATION SEQUENCE OF VARIOUS ELEMENTS IN PREALPINE LAKES,
Konstanz Univ. (Germany, F.R.). Limnological Inst.
For primary bibliographic entry see Field 2J.
W87-06133

PAVIN CRATER LAKE,
Ecole Normale Superieure, Paris (France). Lab. de Geologie.
J. M. Martin.
IN: Chemical Processes in Lakes, John Wiley and Sons, New York, New York. 1985. p 169-188, 11 fig, 2 tab, 50 ref.

Descriptors: *Lake morphology, *Pavin Crater Lake, *France, *Path of pollutants, *Chemical processes, Atmospheric deposition, Lake stratification, Zinc, Lead, Copper, Cesium, Iron, Radioisotopes, Trace metals.

The Pavin Crater Lake (Massif Central, France) is a small and well-defined ecosystem characterized by the occurrence of two stratified oxic and anoxic layers. The characteristics of Pavin Lake have been reassessed by using the lake as a 'test tube' to investigate aquatic processes. The lake's location in a remote area where detrital input is insignificant, greatly favors its use as a giant 'rain gauge' to register atmospheric fallout. Redox processes can be easily studied because of lake stratification and meromixia. The simplicity of the ecosystem, which is basically constituted of diatoms, might facilitate the study of biological cycling of trace metals and artifical radionuclides. The data show an average sedimentation accumulation rate of 1.5 mm/yr (11.5 mg/sq cm/yr) at 92 m. The deposition of atmospheric pollutants, Zn, Cu, and Pb, shows a gradual increase since the beginning of industrialization. Trace metals and artificial radionuclides, such as plutonium, are known to be adsorbed onto the oxyhydroxides of iron and manganese, while there are few examples of mobilization of 137-Cs under the aerobic conditions studied here. (See also W87-06126) (Lantz-PTT)
W87-06134

PHOSPHATE INTERACTIONS AT THE SEDIMENT-WATER INTERFACE,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
P. Baccini.
IN: Chemical Processes in Lakes, John Wiley and Sons, New York, New York. 1985. p 189-205, 14 fig, 2 tab, 20 ref, append.

Descriptors: *Phosphates, *Sediment-water interfaces, *Limnology, *Chemical analysis, *Lake sediments, Oxidation-reduction potential, Iron, Phosphorus, Aerobic conditions, Organic matter, Nitrites, Manganese, Anaerobic conditions, Chemical processes, Sinks, Seasonal variation.

Lake sediments of different chemical composition and different trophic levels show strong seasonal variations of their phosphorus fluxes. These phenomena cannot be explained solely on the basis of the redox conditions and the iron/phosphorus chemistry at the sediment-water interface. A more detailed physical, chemical, and biological analysis of the system 'boundary layer' elucidates the processes which are mainly responsible for the dynamics of phosphorus transport. In an aerobic zone the microbial decomposition of incoming particulate organic matter utilizes the electron acceptors O2 and NO3(-). Freshly imported phosphorus is kept in the solid phase. Bioturbation increases the flux of dissolved species to the hypolimnion. The manganese (II) flux can be used to quantify its contribution. The observed net flux of phosphorus stems from the anaerobic zones, where there is not bioturbation. At the interface of the two zones a chemical barrier for phosphate is formed offering newly formed iron oxides as adsorbing surfaces. The capacity of this phosphorus sink depends on the stoichiometric Fe/P ratio in the dissolved phase of the anaerobic zone. A dynamic physical-chemical model utilizing a set of eight reactions with the state variables organic carbon, oxygen, iron (II), iron (III), and phosphate is introduced. (See also W87-06126) (Author's abstract)
W87-06135

INFLUENCE OF COAGULATION AND SEDIMENTATION ON THE FATE OF PARTICLES, ASSOCIATED POLLUTANTS, AND NUTRIENTS IN LAKES,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W87-06136

COUPLING OF ELEMENTAL CYCLES BY ORGANISMS: EVIDENCE FROM WHOLE-LAKE CHEMICAL PERTURBATIONS,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
D. W. Schindler.
IN: Chemical Processes in Lakes, John Wiley and Sons, New York, New York. 1985. p 225-250, 10 fig, 4 tab, 76 ref.

Descriptors: *Lake morphology, *Limnology, *Chemical properties, *Fate of pollutants, *Path of pollutants, *Microorganisms, Phosphorus, Nitrogen, Sulfur, Photosynthesis, Algae, Chemical processes, Decomposition, Nitrification, Denitrification.

Altering the inputs of phosphorus, nitrogen, or sulfur to lakes has had profound effects on the chemical cycles of other elements, largely by changes induced in organisms which couple the various cycles. Changes caused by phosphorus addition included enhancing photosynthesis which stimulates CO2 invasion from the atmosphere; increased fixation of atmospheric nitrogen caused by changes to blue-green algae when nitrogen/phosphorus ratios were reduced; and replacement of oxic biogeochemical processes by anoxic pathways, including methanogenesis, sulfate reduction, production of ammonium, and release from sediments of ferrous iron. Nitrogen additions caused changes in the acid-base balance of lakes, depending on whether a cationic or anionic form of the nutrient was used. Algal uptake, decomposition, nitrification, and denitrification all appeared to be key processes in the production or consumption of alkalinity, by altering the charge balance between cations and anions. Addition of sulfuric acid caused an increased reduction of sulfate to sulfide in anoxic hypolimnions, and an increased sedimentation of iron sulfides. Because annual input of dissolved iron to lakes is small, it is possible that anthropogenic activities could introduce enough sulfate to lakes to totally deplete their reserves of iron, severely altering the end products of sulfate reduction and disrupting cycles of phosphorus and trace elements. The interfaces between air and water, epilimnion and hypolimnion, and water and sediment are key sites of activity in the biological coupling of geochemical cycles. These biological coupling mechanisms appear to be unimpaired over wide ranges of acidities and nutrient concentrations, despite the numerous changes in biota which occur. (See also W87-06126) (Author's abstract)
W87-06137

METAL TRANSFER MECHANISMS IN LAKES; THE ROLE OF SETTLING PARTICLES,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
For primary bibliographic entry see Field 5B.
W87-06139

CHEMISTRY OF BOG WATERS,
Minnesota Univ., Minneapolis.
E. Gorham, S. J. Eisenreich, J. Ford, and M. V. Santelmann.
IN: Chemical Processes in Lakes, John Wiley and Sons, New York, New York. 1985. p 339-363, 8 fig, 7 tab, 39 ref. NSF Grant No. DEB 7922142.

Descriptors: *Bogs, *Acid rain, *Path of pollutants, *Chemical analysis, *Water chemistry, *Fate of pollutants, *Wetlands, Hydrogen ion concentration, Calcium, Fens, Sodium, Chlorides, Magnesium, Sulfates, Nitrates.

The transformation of fens receiving water from mineral soil to bogs receiving only atmospheric deposition is marked by a sharp decline in pH from above 6 to about 4 as calcium declines below 350 milliequivalents/L. The chemistry of bog waters is influenced chiefly by atmospheric deposition of sea spray in coastal areas (increasing sodium, chloride, and magnesium), and by dustfall from cultivated prairies in continental areas (increasing calcium, magnesium, and in lesser degree, potassium). In some locations air pollution appears to increase sulfate levels. Sulfate, nitrate, and ammonia are all much lower than in atmospheric precipitation, due presumably to plant uptake and microbial reduction. Sulfate reduction is particularly marked in oceanic sites. The low pH in bog waters is owed chiefly to yellow-brown organic acids, as indicated by highly significant interrelationships among anion deficit, hydrogen ion concentration, absorbance and 'dissolved' organic carbon; pH also rises sharply upon photo-oxidation of water samples. Bog drainage is a signficant input to the waters of many lakes and streams, and may predispose them to the further effects of acid deposition from the atmosphere. (See also W87-06126) (Author's abstract)
W87-06141

LAKE RESTORATION,
Eidgenoessische Technische Hochschule, Zurich (Switzerland).

R. Gachter, and D. M. Imboden.
IN: Chemical Processes in Lakes, John Wiley and Sons, New York, New York. 1985. p 365-388, 15 fig, 4 tab, 30 ref.

Descriptors: *Lake restoration, *Phosphorus, *Eutrophic lakes, *Water pollution effects, Hypolimnion, Oxygen, Lake sediments.

A one-box model for the mass balance of total phosphorus in lakes serves to assess the effect of various techniques to restore eutrophic lakes. It is shown that net removal rate of phosphorus to the sediments is highly dependent on the phosphorus content of the lake. Due to this nonlinear behavior, the dynamics of the eutrophication and recovery process may differ markedly. In those cases where the external phosphorus loading cannot be reduced as quickly as desired or as efficiently as required, within certain limitations lake internal measures may be useful. Hypolimnic discharge of water may increase the tolerable mean inflow concentration by 40 mg/cu m at best, and oxygen input into the hypolimnion may augment the phosphorus retention of (mainly mesotrophic) lakes up to 80%. (See also W87-06126) (Author's abstract)
W87-06142

KINETICS OF CHEMICAL PROCESSES OF IMPORTANCE IN LACUSTRINE ENVIRONMENTS,
California Inst. of Tech., Pasadena. Dept. of Environmental Engineering Science.
For primary bibliographic entry see Field 2K.
W87-06143

SOME SELECTED EXAMPLES OF EUTROPHICATED EUROPEAN LAKES,
Commission of the European Communities, Ispra (Italy). Joint Research Centre.
O. Ravera.
IN: Pollutants and Their Ecotoxicological Significance, John Wiley and Sons, Chichester, England, 1985. p 177-187, 1 fig, 1 tab, 21 ref.

Descriptors: *Water pollution effects, *Eutrophic lakes, *Eutrophication, *Path of pollutants, *Europe, *Water quality control, Water management, Algae, Oxygen, Phosphorus, Sewage, Lake Lugano, Lake Annecy, Greifensee, Mauensee.

Eutrophication means the enrichment of a water body with substances (nutrients) which increase the growth rate of plant populations, i.e. macrophytes and phytoplankton. The various effects of eutrophication are the following: (a) degradation of water quality, with consequent higher costs of the supply; (b) modification of the community structure; (c) negative influence on the fishing quality; (d) reduction of tourist and sporting activities; (e) increasing frequency of pathogenic microorganisms, and in some cases, of toxic algae; (f) oxygen depletion in deep layers. Sewage, agriculture, industries, soil leaching and erosion and dry and wet fall-out are the most important sources of the nutrients which enrich lakes. Because the most common limiting factor is phosphorus, to stop trophic development, reduce its rate and/or to decrease the trophic degree of a lake, the phosphorus discharged into the lake must be reduced. Phosphorus removal from sewage or the diversion of waste waters outside the watershed are the most efficient methods of recovering eutrophicated lakes. Efforts devoted to recovering inland waters are, however, not proportional to their degradation. Consequently, the trophic evolution of these water bodies is accelerated. As an example, some European lakes (Lake Lugano, lake Annecy, Greifensee, and Mauensee) with different characteristics have been chosen to illustrate the effects obtained from different interventions. Future topics of the research on lake eutrophication are discussed. (See also W87-06187) (Lantz-PTT)
W87-06189

MODELS OF WATER QUALITY IN RIVERS,
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
D. J. Elliott, and A. James.
IN: An Introduction to Water Quality Modelling, John Wiley and Sons, Chichester, England. 1984. p 74-108, 22 fig, 6 ref, 2 append.

Descriptors: *Model studies, *Rivers, *Path of pollutants, Water quality control, Water quality management, Hydrodynamics, Mathematical models, Mathematical equations, Biological oxygen demand, Dissolved oxygen, Water pollution sources.

Rivers have traditionally been used for the disposal of domestic and industrial wastewaters. In many cases, this has caused undesirable changes to the aquatic flora and fauna. The majority of these changes have been brought about by the discharge of organic matter (BOD) resulting in the lowering in the concentration of the dissolved oxygen (DO) in the receiving water. Pollution of rivers and estuaries is also frequently caused by the discharge of toxic substances, which may break down due to chemical or bacterial action (non-conservative) or which may be resistent to breakdown (conservative) and other problems may arise due to the discharge of inorganic nutrients causing excessive algal growth. In all of these situations it is important to be able to relate the rate of discharge of the pollutant to resulting concentration pattern in the receiving water. Various methods have been devised for calculating the pattern beginning with the classic work on BOD/DO models in the 1920s. This laid the basis for modeling the chemical kinetics of breakdown. Subsequent work has concentrated on the hydrodynamic aspects - advection and diffusion along with work on stochastic and statistical models, and refinement of the kinetic models. Discussed here is the hydrodynamic basis for models of rivers followed by examples of their application. (See also W87-06216) (Lantz-PTT)
W87-06221

LAKE AND RESERVOIR MODELLING,
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
A. James.
IN: An Introduction to Water Quality Modelling, John Wiley and Sons, Chichester, England. 1984. p 129-149, 8 fig, 4 ref, 2 append.

Descriptors: *Lakes, *Model studies, *Reservoirs, Water quality control, Water quality management, Organic matter, Plankton, Eutrophication, Algal growth, Nutrients, Inorganic compounds, Mathematical models, Mixing.

The modeling of water quality in lakes and reservoirs is rather different from that in rivers and estuaries. The primary uses of the water - amenity, fisheries and abstraction are the same but the pollution pattern shows two major differences: (a) Lakes and reservoirs rarely receive discharges of organic matter large enough to cause serious oxygen depletion; (b) Due to the much greater retention time (and depth), lakes and reservoirs are dominated by planktonic organisms and are therefore more sensitive than rivers and estuaries to eutrophication. The majority of models of lakes and reservoirs are therefore concerned with algal growth and inorganic nutrients. The quality of water in lakes and reservoirs is due to a combination of groups of factors, namely: (a) Influent quality and mixing pattern; (b) Physical and chemical processes during storage; and (c) Biological growths and their role in the removal and release of substances. Modeling water-quality changes in lakes therefore involves representation of all these factors, and they are discussed separately with the emphasis on algal growth and its relation with nitrogen and phosphorus. (See also W87-06216) (Lantz-PTT)
W87-06223

FLOOD FORECASTING FOR A POTENTIAL SPIRIT LAKE DEBRIS DAM BREAK,
National Weather Service, Portland, OR. Northwest River Forecast Center.
D. C. Garen.
IN: A Critical Assessment of Forecasting in Water Quality Goals in Western Water Resources Management, Proceedings of a Symposium held in Seattle, Washington, June 11-13, 1984. 1985. p 63-72, 9 fig, 3 tab, 6 ref.

Descriptors: *Flood forecasting, *Spirit Lake, *Dams, *Toutle River, *Cowlitz River, Water management, Management planning, Surface flow, Data interpretation.

Since the natural outlet to Spirit Lake was blocked during the May 18, 1980, eruption of Mount St. Helens, the threat exists that the lake will breach this material, causing catastrophic flooding downstream. The National Weather Service Dam Break Model was used to evaluate the flood hazards posed by Spirit Lake during hypothetical dam break scenarios. The water surface profile within the lake was studied to determine if a significant gradient would exist during a dam break, and if so, whether it could be measured by approximately placed lake gages and used to estimate lake outflow. It was found that no significant gradient would develop in the main body of the lake and that lake outflow could best be measured using the rate of lake level drop in conjunction with a capacity-elevation table. A graphical method was developed to determine the rapidity of the breach from the rate of lake level drop, which is necessary to know for downstream forecasting. The lake outflow was routed down the Toutle and Cowlitz Rivers to develop information for preparing flood forecasts. Scenarios studied included 4, 8, 24, and 48 hour breach times and sediment concentrations of 27 and 40% by volume. (See also W87-06238) (Author's abstract)
W87-06246

APPLICATION OF STREAMFLOW FORECASTS TO OPERATING A MULTI-RESERVOIR SYSTEM IN CENTRAL ARIZONA,
HyMet Co., Seattle, WA.
For primary bibliographic entry see Field 2E.
W87-06247

SEASONAL INFLOW FORECASTS BY A CONCEPTUAL HYDROLOGIC MODEL FOR MICA DAM, BRITISH COLUMBIA,
British Columbia Hydro and Power Authority, Vancouver. Operations Engineering Div.
D. J. Druce.
IN: A Critical Assessment of Forecasting in Water Quality Goals in Western Water Resources Management, Proceedings of a Symposium held in Seattle, Washington, June 11-13, 1984. 1985. p 85-91, 3 fig, 6 tab, 5 ref.

Descriptors: *Seasonal variation, *Hydrologic models, *Mica Dam, *British Columbia, *Revelstoke Dam, *Kinbsaket Lake, *Streamflow forecasting, Model studies, Forecasting.

During the construction of the Revelstoke Dam across the Columbia River, the operation of the Mica Project, located about 135 km upstream, was planned so that the streamflows at Revelstoke would be regulated to less than the discahrge capacity of the diversion facilities, with a high degree of reliability.This was accomplished through the use of an operating procedure which took into consideration the uncertainty in the seasonal inflows to Kinbasket Lake, the reservoir behind Mica Dam. The probabilistic forecasts of seasonal inflows that were input to the procedure were generated using a conceptual hydrologic model. It can be concluded from this evaluation of seasonal inflow volume forecasts for Kinbasket Lake that for the six-year period: (1) the seasonal inflow volume forecasts produced using a conceptual hydrologic model have been more accurate than the official BC Hydro forecasts produced using a regression model; (2) the improvement in forecast accuracy is more pronounced when the inflow for August and September are included in the seasonal inflow volume; (3) the monthly (July) inflow voluem forecasts produced using a conceptual hydrologic model have been more accurate than the official forecasts that are based on pro-rating the seasonal inflow volume forecasts produced using a regression model; (4) the variation in the July inflow volume forecasts caused by meteorological uncertainty decreases considerably as the 1 July date is approached; and (5) both methodologies produce forecasts that are more reliable than the (no-model) forecasts based only on historical in-

flows. Furthermore, it appears that the probabilistic seasonal inflow forecasts produced using the conceptual hydrologic model have some properties that will facilitate the development of better operations planning models for hydro-electric projects. (See also W87-06238) (Lantz-PTT)
W87-06248

ESTIMATING WATER SURFACE ELEVATION PROBABILITIES FOR THE GREAT SALT LAKE,
Utah Water Research Lab., Logan.
L. D. James, D. S. Bowles, R. V. Canfield, D. G. Chadwick, and N. Stauffer.
IN: A Critical Assessment of Forecasting in Water Quality Goals in Western Water Resources Management, Proceedings of a Symposium held in Seattle, Washington, June 11-13, 1984. 1985. p 93-108, 6 fig, 18 tab, 16 ref.

Descriptors: *Water level, *Great Salt Lake, *Ecological effects, *Streamflow forecasting, Floods, Terminal lakes, Model studies, Hydrologic models, Water management.

Rising water surface elevations in terminal lakes threatent shoreline industrial plants, transportation routes, and wetlands. Falling elevations increase the cost of pumping brines into evaporation ponds and reduce the quality of shoreline recreation. The managers of these properties need information on lake level probabilities for planning and protecting their operations, and public agencies need information on both probabilities and damages to determine whether lake level control is justified. Standard methods for estimating flood frequencies and damages in riverine areas do not apply to terminal lakes because of the interdependency in annual peaks, the long advance warning, and the long duration of flood events. The method developed began by utilizing a multivariate first order autoregressive model to generate sequences of annual precipitation, evaporation, and surface inflow. These sequences were then supplied to a lake water balance model to generate lake level sequences. These were used to define lake level probability distributions year by year. They were also supplied to a model that simulated damages used in the economic assessments of causeway breaching (favorable), pumping excess water into the western desert (marginal), and reservoir construction (favorable only in a multipurpose project) as lake level control alternatives. (See also W87-06238) (Author's abstract)
W87-06249

GREAT LAKES WATER QUALITY,
Ontario Ministry of the Environment, Toronto.
For primary bibliographic entry see Field 5G.
W87-06272

IMPACT OF METHOXYCHLOR ON FRESHWATER COMMUNITIES OF PLANKTON IN LIMNOCORRALS,
Guelph Univ. (Ontario). Dept. of Environmental Biology.
For primary bibliographic entry see Field 5C.
W87-06330

HYDROLOGY OF A WETLAND IN THE CONTINUOUS PERMAFROST REGION,
McMaster Univ., Hamilton (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 2C.
W87-06380

SPRING RUNOFF RETENTION IN PRAIRIE POTHOLE WETLANDS,
South Dakota Cooperative Fishery Research Unit, Brookings.
D. E. Hubbard, and R. L. Linder.
Journal o. Soil and Water Conservation JWSCA3, Vol. 41, No. 2, p 122-125, March-April 1986. 1 fig, 2 tab, 40 ref. Federal Aid in Wildlife Restoration Project W-75-R.

Descriptors: *Prairie potholes, *Wetlands, *Spring thaw, Aerial photography, Water depth, Glacial drift, Management planning, Rainfall-runoff relationships, Altamont moraine, Water resources development.

The volume of water in 213 small wetlands on 648 ha of the Altamont moraine in northeastern South Dakota was measured in April 1982, immediately after the vernal thaw. Water depths were measured to the nearest centimeter at intervals along transects through each wetland. The surface area of each wetland was obtained from low-level, black-and-white aerial photographs obtained at the same time the water depth measurements were made. The 213 wetlands comprised 50% of the water surface area that occurred in the study area and contained an estimated 19.58-ha-m of water. The data are discussed in relation to what is known about prairie wetland hydrology. Values of intact prairie wetlands should be given serious consideration in water resource planning and development of the glaciated prairie region. (Author's abstract)
W87-06401

UTILIZATION OF SULFONIC ACIDS AS THE ONLY SULFUR SOURCE FOR GROWTH OF PHOTOSYNTHETIC ORGANISMS,
Munich Univ. (Germany, F.R.). Botanisches Inst.
S. Biedlingmaier, H.-P. Kost, and A. Schmidt.
Planta PLANAB, Vol. 169, No. 4, p 518-523, December 1986. 2 fig, 3 tab, 34 ref.

Descriptors: *Plant growth, *Sulfonic acids, *Organic acids, *Sulfur compounds, *Sulfur, *Photosynthesis, Algae, Algal growth, Bacteria, Plant tissues, Nutrients, Bioaccumulation, Limiting nutrients.

Growth on ethanesulfonic acid as the only sulfur source was found to occur in ten of the 14 green algae tested and the three of the ten cyanobacteria analyzed. Similar growth was not demonstrated in the higher plant Lemna minor, or in tissue cultures of anise, sunflower and tobacco. Organisms growing on sulfonic acids as the only sulfur source developed an uptake system for ethanesulfonate found neither in algae growing on sulfate nor in algae unable to utilize sulfonic acids for growth. The development of sulfonate transport was not caused by substrate induction, but by conditions of starvation. The presence of this uptake system was always correlated with an increased sulfate-uptake capacity. Enhanced sulfate uptake was found in all S-deficient and sulfonate-grown cultures tested, indicating sulfate limitation as the regulatory signal. A lag period of 2-2.5 h after transfer to sulfate deprivation was needed for expression of both enhanced sulfate uptake and ethanesulfonate uptake in the case of the green alga Chlorella fusca. It is speculated that the availability of sulfate (pool size) or a metabolic product in equilibrium with oxidized sulfur compounds controls sulfate and sulfonate uptake systems. The principle of (coordinated) derepression by starvation is discussed as a general strategy in photosynthetic organisms. (Author's abstract)
W87-06404

RA-226 CONCENTRATIONS IN OTTER, LUTRA CANADENSIS, TRAPPED NEAR URANIUM TAILINGS AT ELLIOT LAKE, ONTARIO,
Toronto Univ. (Ontario). Inst. for Environmental Studies.
For primary bibliographic entry see Field 5B.
W87-06421

ORGANOCHLORINE INSECTICIDES IN TROUT, SALMO TRUTTA FARIO L., TAKEN FROM FOUR RIVERS IN LEON, SPAIN,
Universidad de Leon (Spain). Dept. of Biochemistry.
For primary bibliographic entry see Field 5B.
W87-06423

SIZE DISTRIBUTION OF AUTOTROPHY AND MICROHETEROTROPHY IN RESERVOIRS: IMPLICATIONS FOR FOODWEB STRUCTURE,
Oak Ridge National Lab., TN. Environmental Sciences Div.
B. L. Kimmel.
Available from the National Technical Information Service, Springfield, VA. as DE82-017531. ORNL Report No. CONF-8106240--1, 1981. 26 p, 4 tab, 39 ref. Project No. A-088-OKLA.

Descriptors: *Particle size, *Reservoirs, *Food chains, *Autotrophy, *Heterotrophy, *Limnology, Phytoplankton, Eutrophication, Carbon radioisotopes, Tracers.

Particle size is a primary determinant of resources available to consumers and of the efficiency of energy transfer through planktonic food chains. Dual radioisotopic labeling (with 14-C bicarbonate and 3-H acetate) and size fractionation of naturally occurring phytoplankton-bacterioplankton assemblages were employed to examine the particle size distributions of planktonic autotrophy and microheterotrophy in four limnologically-dissimilar U.S. reservoirs (Lake Mead, Arizona-Nevada, oligo-mesotrophic; Broken Bow Lake, Oklahoma, mesotrophic; Lake Texoma, Oklahoma-Texas, eutrophic; and Normandy Lake, Tennessee, eutrophic). Small nano- and ultraphytoplankton (< 8.0 micrometers) and free-living bacteria (< 3.0 micrometers) were primarily responsible for planktonic autotrophy and microheterotrophy, respectively, even in eutrophic conditions. Zooplankton grazing experiments indicated that (1) most grazing pressure occurs on 3.0 to 8.0 micrometer particles, (2) grazer limitation of the occurrence of attached bacteria and microbial-detrital aggregates is unlikely, and (3) free-living bacteria are inefficiently harvested, relative to algae, by most reservoir zooplankton. Autotrophic particulate production is generally more available to filter-feeding zooplankton than is microheterotrophic production due to (1) the smaller particle size of most free-living bacteria relative to most microalgae, and (2) the apparent sparsity of bacteria-colonized particles and microbial-detrital aggregates. Relative to autotrophy, the microheterotrophic conversion of allochthonous dissolved organic matter and algal excretion products to bacterial biomass appears unlikely to be a significant source of organic carbon for planktonic grazers in most reservoirs. (Author's abstract)
W87-06434

LAKE AND RESERVOIR RESTORATION,
Kent State Univ., OH. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5G.
W87-06446

SPATIAL AND TEMPORAL DISTRIBUTION OF SULFIDE AND REDUCED METALS IN THE TAILWATER OF NARROWS DAM (LAKE GREESON), ARKANSAS,
Ouachita Baptist Univ., Arkadelphia, AR. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W87-06518

CE-QUAL-R1: A NUMERICAL ONE-DIMENSIONAL MODEL OF RESERVOIR WATER QUALITY: USER'S MANUAL.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
Available from the National Technical Information Service, Springfield, VA. 22161. Instruction Report E-82-1, July 1986. Final Report. 512 p, 101 fig, 41 tab, 377 ref, 6 append.

Descriptors: *Mathematical models, *CE-QUAL-R1, *Path of pollutants, *Reservoirs, Water quality, Manuals, Reservoir operation, Eutrophication, Model studies.

CE-QUAL-R1 is a mathematical model of water quality that describes the vertical distribution of thermal energy and biological and chemical materials in a reservoir through time. It is used to study preimpoundment and post-impoundment water quality problems and the effects of reservoir management operations on water quality. In addition, it addresses problems of water quality associated

with reservoir eutrophication and with anaerobic conditions. The manual is organized into five major parts with several appendices. Part I introduces CE-QUAL-R1 to the reader by summarizing its major usages, attributes, and historical development. Part II addresses model capabilities, assumption and limitations, and basic equations. Part III is concerned with specific constructs of CE-QUAL-R1 It describes each subroutine in detail. Part IV describes how to determine the various coefficients, constants, and updates required by CE-QUAL-R1, and Part V describes a number of utilities associated with CE-QUAL-R1. (Lantz-PTT)
W87-06520

EVALUATION OF LARVAL FISH SAMPLING GEARS FOR USE ON LARGE RIVERS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 7B.
W87-06521

SIZE DISTRIBUTION OF PLANKTONIC AUTOTROPHY AND MICROHETEROTROPHY IN DEGRAY AND WEST POINT RESERVOIRS: A COMPARATIVE STUDY,
Oak Ridge National Lab., TN. Environmental Sciences Div.
B. L. Kimmel, and A. W. Groeger.
Available from the National Technical Information Service, Springfield, VA. 22161. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS. Technical Report E-86-8, July 1986. Final Report. 45 p, 12 fig, 7 tab, 92 ref.

Descriptors: *Plankton, *Distribution patterns, *DeGray Reservoir, *West Point Reservoir, *Particle size, *Limnology, Algae, Heterotrophic bacteria, Reservoirs.

Particle size is an important determinant of food resources available to planktonic consumers and of the efficiency of energy transfer through planktonic foodwebs. Thus, the environmental factors controlling the size distributions of planktonic autotrophy (algal photosynthesis) and microheterotrophy (bacterial heterotrophic activity) are of considerable ecological interest. To examine hypotheses regarding their environmental control, the author compared the size distributions of planktonic autotrophy and microheterotrophy within and between oligotrophic DeGray Reservoir (Arkansas) and eutrophic West Point Reservoir (Alabama-Georgia). Naturally occurring assemblages of reservoir phytoplankton and bacterioplankton and radiolabeled with sodium 14-C-bicarbonate and sodium 3-H-acetate and were size-fractionated by filtration through polycarbonate membrane filters. Planktonic autotrophy in both reservoirs was dominated by microalgae, with usually >60% of the total photosynthetic carbon uptake associated with organisms in the <8.0-micrometer size fraction. Microheterotrophic activity in the 0.2-1.0-micrometer size fraction (indicative of small, free-living bacterioplankton rather than of large bacteria or bacteria attached to suspended particles) usually accounted for >80% of the planktonic microheterotrophy. Relative to marked uplake-to-downlake gradients in physical and chemical conditions, size distributions of autotrophy and microheterotrophy were remarkably uniform in both reservoirs. The results suggest that additional ecological factors (e.g., size-selective losses of cells by grazing and/or sinking, autograph-microheterotrophy interactions) must be considered, in addition to the availability of nutrients and suspended particles, as potential environmental controls on the size distributions of planktonic autotrophy and microheterotrophy. (Lantz-PTT)
W87-06522

ASSESSMENT OF RESERVOIR MIXING PROCESSES,
Ford, Thornton, Norton and Associates Ltd., Little Rock, AR.
D. E. Ford, and L. S. Johnson.
Available from the National Technical Information Service, Springfield, VA. 22161. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS. Technical Report E-86-7, July 1986. Final Report. 162 p, 64 fig, 4 tab, 176 ref, 2 append.

Descriptors: *Reservoir operation, *Mixing, *Hydrothermal studies, Mathematical analysis, Computer programs, Literature review, Algorithms, Reservoirs, Lakes, Environmental effects.

Since mixing and the resultant hydrothermal regime are dominant factors in determining what takes place chemically and biologically in a reservoir, techniques for predicting the characteristics of the major mixing mechanisms that occur in reservoirs can help the US Army Corps of Engineers (CE) regulate the quality of reservoir and release waters. This report provides a literature review of reservoir internal mixing processes, in which general transport processes, reservoir mixing processes and their effect on water quality, and one-dimensional predictive techniques and computer algorithms are presented and analyzed. The historical development of the recommended predictive techniques, including the assumptions, limitations and advantages of the techniques used in the development, is also documented. The recommended one-dimensional mixing algorithm is generalized with respect to CE reservoirs and is not constrained by extensive data requirements nor limited in the mixing processes considered. The algorithm includes all major mixing processes in order to predict changes in the reservoir's mixing regime resulting from changes in hydrometeorological conditions and project operation. The recommended algorithm was used to simulate the thermal structure of over 15 reservoirs and lakes of varying geographical locations, size, hydrometeorological regime, and operational configurations. The recommendations for the mixing algorithm are the opinions of the authors, and all phases of it are not necessarily incorporated in the current one-dimensional CE reservoir model (CE-QUAL-R1). (Author's abstract)
W87-06523

AQUATIC BIOTA ASSOCIATED WITH CHANNEL STABILIZATION STRUCTURES AND ABANDONED CHANNELS IN THE MIDDLE MISSOURI RIVER,
Iowa Cooperative Fishery Research Unit, Ames.
For primary bibliographic entry see Field 4A.
W87-06524

MACROINVERTEBRATE GEAR EVALUATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 7B.
W87-06525

WATER QUALITY, MACROINVERTEBRATES, LARVAL FISHES, AND FISHES OF THE LOWER MISSISSIPPI RIVER - A SYNTHESIS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
D. C. Beckett, and C. H. Pennington.
Available from the National Technical Information Service, Springfield, VA. 22161. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS. Technical Report E-86-12, September 1986. Final Report. 136 p, 31 fig, 21 tab, 70 ref, 2 append.

Descriptors: *Macroinvertebrates, *Fish, *Mississippi River, *Water quality, Rivers, Larvae, River flow, Suspended solids, Turbidity, Light intensity, Hydrogen ion concentration, Nutrients, Dikes, Channels.

This is a synoptic report describing water quality and composition and distribution of benthic macroinvertebrates, larval fishes, and fishes within a 62-mile reach of the lower Mississippi River. Major water quality differences among habitats were related to the presence or absence of current. Continual flow and high turbulence in lotic habitats such as the main channel and permanent secondary channel resulted in high suspended solids concentrations, high turbidities, low water transparencies, and low light penetration. Such physical characteristics resulted in low algal biomass, more stable pH and dissolved oxygen levels, and the constant availability of algal nutrients. In contrast, lentic areas, such as the abandoned channel at most river stages, and the dike fields at low flows, had relatively lower suspended solids and increased water clarity. This resulted in high algal biomass, higher pH readings, frequent dissolved oxygen supersaturation in surface waters, and nutrient depletion in slack-water areas. The distribution of macroinvertebrates in the lower Mississippi River is a function of the physical characteristics of the system, notably current velocity and substrate composition. Three principal factors determine ichthyoplankton composition and distribution: larval phenology, habitat characteristics, and river stage. These studies have shown that the abandoned channel and dike field pool habitats are of special concern and importance. The placement of dikes and revetments along the river has prevented channel meandering by 'locking' the river into a permanent alignment. Consequently, abandoned channels are rarely created now. Existing abandoned channels should therefore be protected from filling in or being dewatered. The formation of lake-like pools in the dike fields during low flow is precluded by the filling in of these areas. Engineering practices which would prevent or delay the'-terrestrialization' of dike fields should be encouraged in the lower Mississippi River. (Lantz-PTT)
W87-06526

RESERVOIR SHORELINE REVEGETATION GUIDELINES,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 4A.
W87-06527

WETLANDS AND WATER QUALITY: A REGIONAL REVIEW OF RECENT RESEARCH IN THE UNITED STATES ON THE ROLE OF FRESHWATER AND SALTWATER WETLANDS AS SOURCES, SINKS, AND TRANSFORMERS OF NITROGEN, PHOSPHORUS, AND VARIOUS HEAVY METALS,
Rhode Island Univ., Kingston. Graduate School of Oceanography.
For primary bibliographic entry see Field 2L.
W87-06529

EFFECT OF TEMPERATURE AND LIGHT (FLUENCE RATE) ON THE COMPOSITION OF THE TOXIN OF THE CYANOBACTERIUM MICROCYSTIS AERUGINOSA (UV-006),
Orange Free State Univ., Bloemfontein (South Africa). Dept. of Botany.
For primary bibliographic entry see Field 5C.
W87-06555

CARBON INTERRELATIONSHIPS IN A SMALL AQUATIC ECOSYSTEM,
Bucknell Univ., Lewisburg, PA. Dept. of Biology.
J. A. Masser, and W. F. McDiffett.
Archiv fuer Hydrobiologie AHYBA4, Vol. 108, No. 2, p 155-166, December 1986. 4 fig, 2 tab, 23 ref.

Descriptors: *Organic carbon, *Carbon dioxide, *Seasonal variation, *Dissolved solids, Particulate matter, Hydrogen ion concentration, Streams, Ecosystems, Carbon, Alkalinity, Pennsylvania, Nutrients, Primary productivity.

The concentration of dissolved organic carbon (DOC), fine particulate organic carbon (FPOC), free carbon dioxide (CO_2), and alkalinity were measured during a one-year period from June 1982 to May 1983 in a small, highly productive aquatic ecosystem located in Montour County, Pennsylvania. Seasonal changes were found in the system with respect to all parameters; however, free CO_2 was the only parameter which exhibited significant site to site variation. Factors contributing to these differences were probably variations in autochthonous primary production and allochthonous input. The greatest amount of organic carbon exported from the system occurred in the form of

DOC. The highest concentration of DOC (12-16 mg/l) occurred in summer and autumn, with summer values significantly higher than those at any other time. The summer and autumn concentrations of FPOC were also found to be higher than those of winter and spring. (Airone-PTT)
W87-06556

PHENOLOGY AND MICRODISTRIBUTION OF ADULTS AND LARVAE OF FILTER-FEEDING TRICHOPTERA IN A LOWER LAURENTIAN LAKE OUTLET (QUEBEC) (PHENOLOGIE ET MICRODISTRIBUTION DES ADULTES ET DES LARVES DE TRICHOPTERES FILTREURS DANS UN RUISSEAU DES BASSES LAURENTIDES (QUEBEC),
McGill Univ., Montreal (Quebec). Dept. of Biology.
A. Morin, and P.-P. Harper.
Archiv fuer Hydrobiologie AHYBA4, Vol. 108, No. 2, p 167-183, December 1986. 4 fig, 3 tab, 40 ref.

Descriptors: *Aquatic insects, *Microhabitats, *Larvae, *Ecological distribution, *Streams, *Lakes, *Caddisflies, Aquatic populations, Statistical analysis, Model studies, Reproduction.

The emergence pattern, the phenology of nuptial activity, the life cycle, and the microdistribution of adults and larvae of four species of filter-feeding caddisflies are described. Samples were collected in 1972, in 1973 and in 1981-82. Cheumatopsyche pettiti, Hydropsyche betteni, and Hydropsyche sparna are univoltine, whereas Chimarra aterrima (Philopotamidae) is generally bivoltine. The emergence patterns of C. pettiti and C. aterrima are influenced by the regime of precipitations and the water temperature in early summer. Emergence collections reflect the distribution of larvae of the last instar. Larval microdistribution changes during their growth. The four species partition the available space. The larvae of C. aterrima live in a particular microhabitat (the underpart of rocks and artificial substrates), H. sparna inhabits the downstream portion of the outlet, whereas the two other species of Hydropsychidae prefer the area immediately below the lake. C. pettiti and H. betteni inhabit similar microhabitats but their period of maximum production is temporally offset. The observed variations among these species suggest that predictive models that are based on the total density of individuals of a species may be biased in favor of immature stages. Biomass or production would be a better variable for such models. (Airone-PTT)
W87-06557

PERSPECTIVE ON STREAM COMMUNITY ORGANIZATION, STRUCTURE, AND DEVELOPMENT,
Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife.
M. J. Wevers, and C. E. Warren.
Archiv fuer Hydrobiologie AHYBA4, Vol. 108, No. 2, p 213-233, December 1986. 7 fig, 2 tab, 34 ref.

Descriptors: *Streams, *Ecosystems, *Succession, *Macroinvertebrates, Ecological distribution, Aquatic populations, Aquatic drift, Pools, Riffles, Ecology.

Clements' (1916) metaphorical organismic view and Gleason's (1926) individualistic population view are reflected in approaches to the study of streams. Empirical illustrations from laboratory stream communities are used in exploring the possibilities of a perspective integrating the organismic and individualistic views. The communities of two large, outdoor recirculating model streams were studied for a period of one year following an unusually hard winter freeze. A hierarchical scheme of stream community subsystems was conceived and used in interpreting data from the model streams in terms of community development and organization. Biomass and number of taxa within community subsystems were plotted along gradients of substrate particle size and current velocity to illustrate community organization at four points in time. Selected data are presented for each level of the hierarchy: stream community habitat subsystems, microhabitat subsystems within shallow riffles, trophic subsystems within shallow riffle-cobble, and selected species population subsystems within the microphyte herbivore trophic subsystem in shallow riffle-cobble. A stream community is viewed as an integral part of its watershed. Habitat organization is the template upon which stream communities are initially organized. Trophic organization is used to define subsystems at a lower level of organization, within the habitat subsystems. Trophic interdependencies contribute to the integration and stability of aquatic communities. Individual aspects become most apparent at the life history and population levels of community organization. (Life history aspects include dispersal, colonization, phenology, etc.) An integrated perspective on stream systems allows experience in stream systems to be related to experience in other areas of ecology. (Author's abstract)
W87-06559

PHOTOSYNTHESIS OF SIZE-FRACTIONATED PHYTOPLANKTON POPULATION IN HYPERTROPHIC LAKE KASUMIGAURA, JAPAN,
National Inst. for Environmental Studies, Tsukuba (Japan). Environmental Biology Div.
N. Takamura, T. Iwakuma, and M. Yasuno.
Archiv fuer Hydrobiologie AHYBA4, Vol. 108, No. 2, p 235-257, December 1986. 9 fig, 5 tab, 39 ref.

Descriptors: *Hypertrophic lakes, *Lake Kasumigaura, *Nutrients, *Photosynthesis, *Phytoplankton, *Zooplankton, *Primary productivity, *Eutrophication, *Species composition, *Microcystis, Lakes, Carbon, Japan, Size, Biomass, Respiration.

Few studies have dealt with the respective productivities of nanno- and net phytoplankton in coastal waters or in a hypertrophic lake. Thus the photosynthesis and primary production of size-fractionated phytoplankton were studied from June to October 1982 in the hypertrophic Lake Kasumigaura. Four size classes were formed, and chlorophyll A concentration, amount of particulate organic carbon, rates of carbon assimilation and species composition were determined for each class. The primary production of each class was estimated therefrom. Primary production rose from 2 gC/sq m/day in June to 3.7-4.2 in August. Some decreases were measured in September, but all fractions showed recovery in October. The biomass, photosynthetic rate, and primary production of nannoplankton (< 20 micron) were greater than net plankton (> 40 micron) before Microcystis bloomed, but became smaller during the bloom. Microcystis predominated not only among phytoplankton in large fractions but in the small ones as well. The Microcystis colonies < 20 micron, which had a lower photosynthetic rate and a higher respiration rate than the large colonies, were considered to be broken and decomposing colonies. The importance of these colonies as zooplankton food is discussed. (Airone-PTT)
W87-06560

COMPARISON OF SOME PHYSICOCHEMICAL PARAMETERS OF HUMIC SUBSTANCES ISOLATED FROM THREE DIFFERENT AQUATIC ECOSYSTEMS,
Polish Academy of Sciences, Poznan. Dept. of Agrobiology and Forestry.
For primary bibliographic entry see Field 5A.
W87-06561

PHOSPHATE TRANSPORT DURING HYPOLIMNETIC AERATION,
National Water Research Inst., Burlington (Ontario).
For primary bibliographic entry see Field 5G.
W87-06562

VENTILATION ACTIVITY OF CHIRONOMUS LARVAE (DIPTERA) FROM SHALLOW AND DEEP LAKES AND THE RESULTING WATER CIRCULATION IN CORRELATION TO TEMPERATURE AND OXYGEN CONDITIONS (DIE SCHLAENGELAKTIVITAET VON CHIRONO MUSLARVEN (DIPTERA) AUS FLACHEN UND TIEFEN GEWAESSERN UND DIE RESULTIER ENDEN WASSERZIRKULATIONEN IN ABHAENGIGKEIT VON TEMPERATUR UND SAUERSTOFF ANGEBOT),
Cologne Univ. (Germany, F.R.). Lehrstuhl fuer Physiologische Oekologie.
H. Leuchs.
Archiv fuer Hydrobiologie AHYBA4, Vol. 108, No. 2, p 281-299, December 1986. 13 fig, 1 tab, 19 ref.

Descriptors: *Lakes, *Larvae, *Ventilation, *Temperature effects, *Oxygen, *Sediment water interfaces, Measuring instruments, Sedimentology, Benthic fauna, Lake sediments, Midges, Mineralization.

A method is presented for measurement of locomotor activity of Chironomus larvae and of the amount of water they pump through their tubes. Chironomus thummi Kieffer (syn. riparius Meigen) from shallow waters and Ch. anthracinus Zetterstedt from deep lakes were tested. The amount of water pumped through the sediments by the larval population was calculated (about 20 l/day per 1000 larvae at 15 C) and 100% 02). The adaptation of the different pumping behavior of the two species under varying temperature (thummi: dependent; anthracinus: partly independent), and low oxygen concentrations (thummi: higher activity, anthracinus: rest) is discussed. (Author's abstract)
W87-06563

POPULATION CHARACTERISTICS OF ADULT PINK SALMON IN TWO MINNESOTA TRIBUTARIES TO LAKE SUPERIOR,
Minnesota Univ., St. Paul. Dept. of Fisheries and Wildlife.
J. P. Nicolette, and G. R. Spangler.
Journal of Great Lakes Research JGLRDE, Vol. 12, No. 4, p 237-250, 1986. 8 fig, 8 tab, 35 ref.

Descriptors: *Limnology, *Salmon, *Fish populations, *Population dynamics, *Spawning, *Lakes, *Water resources development, Fish barriers, Fish behavior, Fish eggs, Fishing, Recreation, Ecosystems, Lake Superior.

Pink salmon, Oncorhynchus gorbuscha, have adapted well to the Lake Superior environment and have become a significant member of the Great Lakes salmonid community. However, to properly manage pink salmon in this new environment, an improved understanding of their population characteristics is necessary. To gather population information, the following parameters were estimated for the 1981 and 1982 runs of pink salmon in Cascade and Cross Rivers, Minnesota: (1) absolute abundance of spawners, (2) age, size, and sex distribution of the spawners, (3) fecundity and growth of returning adults, and (4) egg deposition, egg fertilization rates, and embryo development. Trap nets were used to collect upstream migrant pink salmon, while electrofishing, carcass counts, and creel censuses were used to obtain recaptures. Left pectoral fin rays were used for aging and growth back calculation. Redd samples were collected to estimate egg fertilization rates and embryo development. It was found that Lake Superior pink salmon are similar to their Pacific Coast counterparts, except that they are smaller (2-year-olds are 25% of the weight of Pacific fish, 3-year-olds are 50%) and 3-year-old fish are common. The latter may preclude the genetic divergence based on spawning stock which is apparent in the Pacific. The sex distribution of 3-year-old pink salmon was heavily skewed towards females. Three-year-old pink salmon had a lower fecundity and a poorer egg quality than 2-year-ol females. The majority of hatching occurs during February and March (among Pacific pink salmon, hatching occurs from late December to late February). The major factor controlling the abundance of Lake Superior pink salmon appears to be limited spawning habitat, caused by the presence of natural fish barriers in the majority of Minnesota tributaries to Lake Superior. (Airone-PTT)
W87-06576

FALL AND WINTER THERMAL STRUCTURE OF LAKE SUPERIOR,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
R. A. Assel.
Journal of Great Lakes Research JGLRDE, Vol. 12, No. 4, p 251-262, 1986. 5 fig, 4 tab, 28 ref.

Descriptors: *Limnology, *Seasonal variation, *Thermal stratification, *Lakes, *Lake Superior, *Bathythermographs, Wind, Thermocline, Navigation, Waterways, Ice formation.

Temperature surveys were made along the normal upbound (westward) and downbound (eastward) shipping lanes across Lake Superior to document fall and winter thermal structure of that lake. Surveys were made aboard ore carriers using a portable bathythermograph (BT) system and expendable BT probes. Surveys usually took 2 to 4 days to complete. Twenty-one surveys were made during the winters of 1973 to 1976 and 25 surveys during the falls of 1976 to 1979. Mean seasonal temperature trends identified from these data include: (1) approximately exponential increase in fall mixed layer depth through early to mid-November, (2) maximum value of average mixed layer and upper 25-m layer temperatures between the end of August and mid-September, (3) maximum value of average water column temperature in late September, (4) isothermal conditions between mid-November and mid-December, (5) completion of fall overturn in December and winter restratification in December or January depending primarily on winds, (6) average winter (January to March) monthly mixed layer depth between 60m and 100m, and, (7) minimum values of average water column temperature in late March. Midlake and nearshore thermal regimes were identified. These thermal regimes show agreement in trend with lake bathymetry, wind fetch, and lake circulation patterns. Deeper areas with longer wind fetch in both thermal regimes have the deepest mixed layers during winter. Areas having the combination of greater depth and larger wind fetch, midlake areas in most cases, also tend to have higher column temperatures and ice cover of short duration in winter and lower column temperatures in summer relative to adjacent areas. (Author's abstract)
W87-06577

DEPTH DISTRIBUTION, DIET, AND OVER-WINTER GROWTH OF LAKE TROUT (SALVELINUS NAMAYCUSH) IN SOUTHEASTERN LAKE MICHIGAN SAMPLED IN DECEMBER 1981 AND MARCH 1982,
National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
G. W. Eck, and L. Wells.
Journal of Great Lakes Research JGLRDE, Vol. 12, No. 4, p 263-269, 1986. 2 fig, 5 tab, 8 ref.

Descriptors: *Trout, *Predation, *Food habits, *Limnology, *Fish populations, *Fish diets, *Lakes, *Predation, *Food habits, *Limnology, *Lake Michigan, Fish behavior, Smelt, Alewife, Sculpin, Ecosystems, Fish stocking, Distribution, On-site data collections.

Lake trout were collected in graded-mesh gill nets and forage fishes were collected in trawls in mid December 1981 and late March 1982. The length ranges of 317 lake trout caught in December and 138 in March were 280-767 and 286-857 mm, and the age ranges I-XI and II-XIV, respectively. Three year classes (1977-1979) made up almost 80% of the catches of lake trout in both sampling periods. Lake trout were most abundant at depth of 18 to 37 m in December (water temperatures, 5.5-6.8 C) and at 28-64 m in March (water temperatures, 1.0-1.3 C). Fish of the 1977-1979 year classes completed 9 to 24% of their annual growth in length, and 14 to 39% of their growth in weight, between mid December and late March. Lake trout ate mainly alewives (Alosa pseudoharengus), especially young-of-the-year, in December, but primarily slimy sculpins (Cottus cognatus) in March, when alewives were mainly at depths greater than those occupied by most lake trout. Other important food items were rainbow smelt (Osmerus mordax) and, in deeper water, deepwater sculpins (Myoxocephalus thompsoni). Bloaters (Coregonus hoyi) were eaten only sparingly, although they were abundantly available in both sampling periods. Perhaps this species, which coevolved with the lake trout in Lake Michigan and was important in the native trout's diet, is better able to avoid capture by the trout then are the exotic alewife and rainbow smelt. It may not again become a major forage species unless the other food sources become scarce. (Author's abstract)
W87-06578

NEARSHORE BENTHIC INVERTEBRATES OF THE ONTARIO WATERS OF LAKE ONTARIO,
Waterloo Univ. (Ontario). Dept. of Biology.
D. R. Barton.
Journal of Great Lakes Research JGLRDE, Vol. 12, No. 4, p 270-280, 1986. 3 fig, 8 tab, 34 ref.

Descriptors: *Invertebrates, *Benthic fauna, *Species composition, *Lakes, *Limnology, *Lake Ontario, *Population density, Upwelling, Water quality, Eutrophication, Waves, Thermal stress, Taxonomy.

Benthic invertebrates were collected by divers along 25 transects (depths of 2, 5, 10, and 20 m) between the Niagara River and Kingston during July 1981. Total standing stocks, which ranged from 1,600/sq m to 314,200/sq m, were greatest on silt and clay, especially near the mouth of the Humber River, and smallest on rock. Of the 196 taxa which were recognized, Vejdovskyella intermedia, immature Tubificidae, Chaetogaster diaphanus, Potamothrix vejdovskyi, Tanytarsus, Pontoporeia hoyi, and Gammarus fasciatus were the most abundant and most frequently collected. Both inspection of the distributions of common taxa and ordination based on abundances of all taxa found at >5 stations indicated that organic enrichment, depth, and susceptibility to upwelling were the primary factors influencing the composition of invertebrate communities. Exposure to wave action was less important, and type of substratum had little effect. Overall, the nearshore fauna of Lake Ontario was less diverse, but more abundant than that of Lake Huron. The efficiencies of certain collection devices (Ponar and Shipek grabs, and an airlift used by the author) are briefly discussed. (Airone-PTT)
W87-06579

LAKE HURON ROTIFER AND CRUSTACEAN ZOOPLANKTON, APRIL-JULY, 1980,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
M. S. Evans.
Journal of Great Lakes Research, Vol. 12, No. 4, p 281-292, 1986. 5 fig, 5 tab, 47 ref.

Descriptors: *Species composition, *Population density, *Limnology, *Zooplankton, *Rotifers, *Crustaceans, Experimental design, *Trophic level, *Lake Huron, Bioindicators, Ecosystems, Grazing, Plankton, Water quality, Food chains, On-site data collections.

Between April and July 1980, four zooplankton surveillance cruises were conducted in Lake Huron waters. Crustacean and rotifer species composition and abundance generally were characteristic of oligotrophic waters. Crustacean zooplankton cruise mean abundances were more than twice as large as those reported from Lake Huron in 1971, although not as high as reported from southern Lake Huron in 1974. Rotifers occurred in even greater abundances in southern Lake Huron in 1974 than over the whole lake in 1980. Differences in abundance across time may reflect changes in the trophic status of the lake or differences in sampling methods and locations. Consistent sampling methods and locations must be used if long-term trends are to be accurately detected. The 1980 zooplankton community was strongly dominated by crustaceans (mean biomass 11.58-53.79 mg C/cu m over the four cruises, compared to 0.03-0.06 mg C/cu m for rotifers), and these are the probable major grazers on the phytoplankton community. Rotifers, because of their possible greater sensitivity to food limitations and their greater potential rate of population increase, may be the best zooplankton indicators of trophic condition. However, crustacean zooplankton may be better indicators of ecosystem structure (because of their vulnerability to fish predators) and function (because of their major role in grazing). (Airone-PTT)
W87-06580

DYNAMICS OF REPRODUCTION BY HATCHERY LAKE TROUT ON A MAN-MADE SPAWNING REEF,
Michigan Dept. of Natural Resources, Marquette. Marquette Fisheries Station.
For primary bibliographic entry see Field 8I.
W87-06581

MOVEMENTS OF RAINBOW STEELHEAD TROUT (SALMO GAIRDNERI) IN LAKE ONTARIO AND A HYPOTHESIS FOR THE INFLUENCE OF SPRING THERMAL STRUCTURE,
State Univ. of New York Coll. at Brockport. Dept. of Biological Sciences.
J. M. Haynes, D. C. Nettles, K. M. Parnell, M. P. Voiland, and R. A. Olson.
Journal of Great Lakes Research JGLRDE, Vol. 12, No. 4, p 304-313, 1986. 3 fig, 3 tab, 48 ref. NOAA Grants 122-S003G and 124-S005G.

Descriptors: *Trout, *Limnology, *Lake Ontario, *Fish behavior, *Thermocline, Spawning, Environmental effects, Sport fishing, Insects, *Temperature effects, Food habits, Migration.

To examine movements of rainbow/steelhead trout (Salmo gairdneri) and associated environmental influences, 28 fish were radiotagged in and near a tributary of Lake Ontario during spring spawning runs in 1981 and 1982. Trout initially entering the lake from the tributary generally exhibited east-west reversals of movement along the southern shore of Lake Ontario before dispersing off shore. Seasonal movement rates averaged 3.2 +/- 1.6 km/d over periods of 6-94 d. Mean short-term rates were 0.50 +/- 0.46 km/h. Temperatures occupied in the lake were 9.1 +/- 1.5 C, temperatures at which fish were last observed were 9.8 +/- 3.8 C. Movements off shore and ultimate disappearances occurred from April to July, but were most pronounced when temperatures near shore exceeded 10 C. By linking trout movements to seasonal thermal structure in Lake Ontario, a testable hypothesis was established to explain the distribution of rainbow trout in spring and early summer. Based on tracking data, information provided by south shore anglers, and literature on the physical limnology of Lake Ontario, we hypothesize that rainbow trout disperse off shore in spring with thermal fronts, particularly the 6-8 C zone known as the spring thermocline. This may be because the thermal fronts appear to concentrate a preferred prey, insects. (Author's abstract)
W87-06582

PORTABLE DEVICE FOR MEASURING SEDIMENT RESUSPENSION,
California Univ., Santa Barbara. Dept. of Mechanical and Environmental Engineering.
For primary bibliographic entry see Field 7B.
W87-06583

RAINBOW SMELT (OSMERUS MORDAX) PREDATION ON SLIMY SCULPIN (COTTUS COGNATUS) IN LAKE ONTARIO,
State Univ. of New York Coll. of Environmental Science and Forestry, Syracuse. School of Landscape Architecture.
S. B. Brandt, and S. P. Madon.
Journal of Great Lakes Research JGLRDE, Vol. 12, No. 4, p 322-325, 1986. 4 fig, 20 ref. NOAA Grant 210-S014 and 228-S011.

Descriptors: *Limnology, *Predation, *Smelt, *Sculpin, *Lake Ontario, *Trout, *Fish food habits, *Fish populations, Ecosystems, Energy, Diets, Food habits, Food chains, Benthos, Fish behavior.

Slimy sculpin (Cottus cognatus) and opposum shrimp (Mysis relicta) formed the primary prey of 319 adult (96-201 mm total length) rainbow smelt (Osmerus mordax) collected day and night at depths of 30-50 m in southeastern Lake Ontario during 21-25 August and 23-31 October 1984. Prey were eaten primarily at night. Between 2000-2400 hours, 77% of rainbow smelt during August and 43% during October contained slimy sculpin, compared to less than 10% during the day. Mean number of sculpin per smelt stomach was 1.2 and 1.5, respectively. Mean sizes of slimy sculpin eaten (total lengths of 12.7 mm in August and 21.1 mm in October) were significantly less than those of sculpin (30.4 mm in August and 31.6 mm in October) caught in trawls at the same depths. Occurrence of opposum shrimp in smelt stomachs also peaked at night at 80-90% and an average of up to 2.1 and 5.2 opposum shrimp were found per smelt stomach in August and October, respectively. We infer that rainbow smelt may compete with juvenile lake trout (Salvelinus namaycush) for slimy sculpin in the Great Lakes. (Author's abstract)
W87-06584

WIND-DRIVEN ICE-PUSH EVENT IN EASTERN LAKE ONTARIO,
Queen's Univ., Kingston (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 2C.
W87-06585

DENSITY AND DISTRIBUTION OF LARVAL FISHES IN PENTWATER MARSH, A COASTAL WETLAND ON LAKE MICHIGAN,
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
S. L. Chubb, and C. R. Liston.
Journal of Great Lakes Research JGLRDE, Vol. 12, No. 4, p 332-343, 1986. 6 fig, 3 tab, 32 ref. Michigan Sea Grant Project R/CW-13.

Descriptors: *Coastal marshes, *Limnology, *Wetlands, *Fish larvae, *Littoral environment, *Population density, *Population dynamics, *Lake Michigan, *Fish populations, Estuaries, Carp, Sunfish, Minnows, Spawning, Taxonomy, Lakes, Great Lakes, Fish.

In order to better understand the importance of a Great Lakes coastal marsh on fish production, the fish larvae of Pentwater Marsh, a drowned river-mouth wetland on Lake Michigan, were studied over a 3-yr period. Fish larvae were sampled at night by push nets in the channels and bayou-mouths and drop nets in the shallow, vegetated bayous of the marsh. Larval fish diversity and abundance were highest in 1984, perhaps due to more stable temperatures, higher water levels, and/or increased submerged vegetational cover. In all years, carp (Cyprinus carpio) dominated the catch with marsh-wide densities of up to 30 larvae/cu m. Subdominant species included sunfish (Lepomis ssp.) and various minnows (Cyprinidae). Eighteen taxa were identified. Larval fish densities were generally higher than documented for other wetland areas. However, previous studies may have underestimated densities since shallow-water sampling was not included and they were conducted during years of low water level. Coastal wetlands likely harbor greater numbers of young fishes than previously reported, emphasizing the importance of such areas to the ecology of the Great Lakes. (Author's abstract)
W87-06586

HYPOTHESIZED CARBON FLOW THROUGH THE DEEPWATER LAKE ONTARIO FOOD WEB,
Stste Univ. of New York Coll. at Oswego. Research Center.
R. W. Flint.
Journal of Great Lakes Research JGLRDE, Vol. 12, No. 4, p 344-354, 1986. 2 fig, 2 tab, 55 ref.

Descriptors: *Food chains, *Limnology, *Carbon, *Energy, *Model studies, *Planning, *Lake Ontario, Fishing, Ecosystems, Policy making, Phytoplankton, Trophic level, Biomass, Nutrients, Predation, Prediction, Lakes, Great Lakes, Fish stocking.

One of the problems potentially facing the Lake Ontario ecosystem is insufficient food for support of the significant increases in piscivore biomass reached through management stocking strategies in this lake. This is especially evident in light of the fact that other management strategies for Lake Ontario have focused on limiting nutrient inputs to lessen eutrophication, thus lowering production at the base of the food web (phytoplankton). A conceptual model of the Lake Ontario deepwater food web, developed using selected literature values, permits prediction of the nutrition available for top level salmonine predators. Trophic links are specified in the model, from base phytoplankton to top-level piscivores, and carbon-transfer values are assigned from the literature. Phytoplankton photosynthesis resulted in 178 g C/sq m/yr production at the base of the food web. Approximately 60% of primary production was counted as required support for pelagic zooplankton and the benthos. Dominant forage fish in the lake (alewife, smelt, and sculpin) appeared to consume all smaller zooplankton and mysid production of carbon, 61% of general benthic community production, and 94% of amphipod carbon production on an annual basis. The food web model indicated that approximately 1.2 g C/sq m/yr was available for support of larger planktivore, benthivore, and piscivore fish. Based upon long-term fishery records and stocking statistics for salmonines. It was calculated that larger fish required approximately half of the annual carbon available for nutritional support. According to the model, trophic rearrangement, such as through fish stocking, can have an important impact on the Lake Ontario food web. It is extremely important that research questions be directed toward addressing the actual biomass and energy value of different prey and quantifying more precise information on energy conversion efficiencies for the different species involved. Such research will improve the confidence with which models can be used. This will improve our understanding of the dynamics of a Great Lakes ecosystem. (Airone-PTT)
W87-06587

GLACIAL AND GLACIOLACUSTRINE EVENTS IN NORTHWESTERN LAKE HURON, MICHIGAN AND ONTARIO,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 2C.
W87-06588

GEOLOGICAL DEVELOPMENT OF LARGE LAKES OF THE HUMID ZONE IN THE EUROPEAN PART OF THE SOVIET UNION, AND HOLOCENE CLIMATIC CHANGES OF THE BASIS OF LAKE SEDIMENT DATA,
Akademiya Nauk SSSR, Leningrad. Inst. Ozerovedeniya.
N. Davydova, and A. Raukas.
Journal of Biogeography JBIODN, Vol. 13, No. 2, p 173-180, March 1986. 6 fig, 6 ref.

Descriptors: *Limnology, *Lakes, *Sediment cores *Geological development, *Soviet Union, *Lake sediments, Geology, Geological eras, Diatom diagrams, Pollen diagrams, Carbon dating, Climate, History.

To determine the geologic history and Holocene climatic changes of large lakes in the Soviet Union lake sediment cores were taken. Diatom and pollen diagrams were drawn and 14C dating was performed. The geological development of the largest European lakes, Ladoga and Onega, were highly dependent upon climatic conditions. In general, the geological history of all lakes of the humid zone, small and large, was similar. (Main-PTT)
W87-06589

INFLUENCE OF MYRIOPHYLLUM SPICATUM L. ON THE SPECIES COMPOSITION, BIOMASS AND PRIMARY PRODUCTIVITY OF PHYTOPLANKTON,
Quebec Univ., Montreal. Dept. of Biological Sciences.
H. Godmaire, and D. Planas.
Aquatic Botany AQBODS, Vol. 23, No. 4, p 299-308, February 1986. 5 fig, 1 tab, 18 ref.

Descriptors: *Phytoplankton, *Primary productivity, *Species composition, *Myriophyllum, *Limnology, *Lake Saint Charles, Quebec, *Biomass, Seasonal variation, Cyanophyta, Diatoms, Macrophytes, Chlorophyta, Chrysophyta, Nutrients, Aquatic plants, Phytoflagellates, Desmids.

The influence of Myriophyllum spicatum on the biomass and species composition of phytoplankton was assessed. Seasonal changes in species composition, total biomass, relative biomass (B) of various phytoplankton groups and productivity (P) and P/B ratio were studied in enclosures containing different macrophyte assemblies. Enclosures were set up in Lake St. Charles which has a low nutrient content. Three types of enclosures were installed in duplicate: M. spicatum, Sparganium and Nuphar microphyllum, and plastic plants similar to M. spicatum in morphometry, size and shading effect. Myriophyllum spicatum in enclosures initially increased phytoplankton productivity per unit biomass relative to enclosures from which it was absent. Phytoflagellates prevailed during the entire season in the presence of M. spicatum, while desmids were dominant in the other communities. The presence of M. spicatum can lead to considerable modification of the littoral phytoplankton community. (Author's abstract)
W87-06595

UPTAKE AND DISTRIBUTION OF 15N2 INTO THE VARIOUS ORGANS OF TYPHA LATIFOLIA L.,
Minnesota Univ., St. Paul. Dept. of Botany.
J. V. Dean, and D. D. Biesboer.
Aquatic Botany AQBOSD, Vol. 23, No. 4, p 309-320, February 1986. 2 fig, 4 tab, 24 ref.

Descriptors: *Bioaccumulation, *Nutrients, *Isotope studies, *Nitrogen isotopes, *Nitrogen, *Cattails, *Isotope studies, *Nitrogen isotopes, *Gas exchange, *Nitrogen, Plant organs, Plants, Leaf bases, Leaves, Propane, Roots, Rhizomes, Diffusion, Aquatic plants.

Direct evidence of heterotrophic dinitrogen fixation associated with the emergent aquatic angiosperm, Typha latifolia, was obtained through the exposure of actively growing plants to 15N2 gas for 7 days in a gas-tight exposure vessel. Highest enrichments of 15N were found in roots/rhizomes and leaf bases. Slight enrichments were also found in the leaves due to translocation from the roots, rhizomes and leaf bases. Total fixed 15N values were 71.8 micrograms for the plant and 49.1 micrograms for the soil. Plants growing in silica sand, which received a nutrient solution containing combined nitrogen, exhibited higher enrichments and fixed 86% more 15N after exposure to 15N2 gas than plants which received a nutrient solution lacking combined nitrogen. Propane was used to trace the loss and movement of gases from the 15N2 vessel and between the upper leaf chamber and the lower root chamber. Gas was rapidly exchanged between the upper and lower chambers through the leaves and roots of T. latifolia. Futher investigations showed that propane moved at a rate of 1223 micromoles/day from the leaves to the roots and 2653 micromoles/day from the roots to the leaves. These data demonstrated that gases diffuse rapidly through the plant body of T. latifolia. (Author's abstract)
W87-06596

VARIATIONS IN LEAF CHARACTERISTICS OF SIX SPECIES OF SAGITTARIA (ALISMATACEAE) CAUSED BY VARIOUS WATER LEVELS,
University of Southern Mississippi, Hattiesburg. Dept. of Biology.
J. W. Wooten.
Aquatic Botany AQBODS, Vol. 23, No. 4, p 321-327, February 1986. 2 tab, 21 ref. NSF Grant DEB 77-00822.

Descriptors: *Sagittaria, *Plant growth, *Water stress, *Leaf characteristics, *Water level, Petioles, Saturated soils, Submerged plants.

Plants grown from seeds of Sagittaria falcata, S. lancifolia, S. platyphylla, S. rigida, S. isoetiformis, and S. papillosa were grown in water-saturated soil or soil submerged to 4.5, 12, 19.5, or 27 cm. Length and width of leaves and petiole lengths were measured at anthesis of the first flower on the first inflorescence produced by each plant. In general, leaf width and length were decreased by submergence, and petiole length increased. The species water depth interaction was significant for emersed leaf width, leaf length and petiole length except for S. lancifolia leaf length and S. papillosa leaf length and width. These trends indicated genetic differences among, and variability within taxa. Leaf width, leaf length and petiole length of plants growing in seed source populations were measured. The means from these measurements, when compared to those from experimental plants, indicated that both groups of plants responded similarly to variations in water depth. (Author's abstract)
W87-06597

GAS EXCHANGE OF TYPHA ORIENTALIS PRESL. COMMUNITIES IN ARTIFICIAL PONDS,
Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Centre for Irrigation Research.
P. J. M. Sale, and P. T. Orr.
Aquatic Botany AQBODS, Vol. 23, No. 4, p 329-339, February 1986. 4 fig, 1 tab, 20 ref.

Descriptors: *Cattails, *Bioaccumulation, *Gas exchange, *Carbon dioxide *Artificial ponds, *Respiration, Photosynthesis, Plant water loss, Assimilation, Plants, Leaf area index, Crop yield, Limnology, Water use efficiency.

Large field chambers were used for measuring the net carbon dioxide exchange of vigorously growing communities of Typha orientalis. Uptake was greatest at the beginning of summer, when that of a community with leaf area index (LAI) 6.8 reached almost 6 g CO2/sq m (water surface area)/h. In a second community with LAI 4.8 maximum uptake was 3.8 g CO2/sq m/h. In both communities there was a marked decline in uptake over the middle part of each day: uptake also declined quite rapidly as the communities aged. Maximum dry weight increases of 30 and 24 g/sq m/24 h for the 2 communities, respectively, were calculated from day-time net assimilation and night-time respiration. Measurements of maximum water loss from the first community showed a water-use efficiency of 7.86, which declined as the summer progressed. The photosynthetic performance of the Typha communities was similar to that of some well-irrigated C3 crop plants grown in similar climate. (Author's abstract)
W87-06598

VEGETATION DYNAMICS IN TEMPORARY AND SHALLOW FRESHWATER HABITATS,
Rajasthan Univ., Jaipur (India). Dept. of Botany.
B. Gopal.
Aquatic Botany AQBODS, Vol. 23, No. 4, p 391-396, February 1986. 37 ref.

Descriptors: *Population dynamics, *Species composition, *Vegetation dynamics, *Freshwater habitats, Plants, Water level variations, Seasonal variations, Literature review, Ecology, Ecophases.

The vegetation dynamics in habitats subject to large seasonal fluctuations in water level was reconsidered in the light of the available literature on the ecological requirements of the plants which occur in different ecophases in these habitats. It is suggested that the water-level change is a component of the normal environment for the vegetation of such habitats, and that the changes in the community structure simply reflect the oscillating shifts in the dominance of various constituent species of an otherwise stable community which is adapted to the particular habitat conditions. (Author's abstract)
W87-06600

STREAM BED CONFIGURATION AND STABILITY FOLLOWING GABION WEIR PLACEMENT TO ENHANCE SALMONID PRODUCTION IN A LOGGED WATERSHED SUBJECT TO DEBRIS TORRENTS,
Poulin (V.A.) and Associates Ltd., Vancouver (British Columbia).
For primary bibliographic entry see Field 8I.
W87-06602

PROCEEDINGS OF THE SYMPOSIUM ON PEAT LANDS BELOW SEA LEVEL.
International Inst. for Land Reclamation and Improvement, Wageningen (Netherlands).
August 24-28, 1981, The Netherlands. IRLI Publication No. 30, 1982. 296 p.

Descriptors: *Peat bogs, *Peat soils, *Land use, *The Netherlands, *Land reclamation, Geology, Geologic history, Peat, Fens, Drainage, Water management, Agriculture, Horticulture, Farm management, Symposium, Vegetation, Geography, Grasslands, Drainage programs, Drainage effects.

The proceedings of this symposium on peat lands contain 24 papers: 18 invited papers (9 papers and their reviews); 2 added papers; and 4 selected items from the excursions. The excursions in the western part of The Netherlands included: a visit to a trial farm with different drainage levels; a trip to newly built suburban quarters where difficulties with constructions in peat areas were demonstrated; a survey of soils, geological conditions, different water levels, and management of polder water; and a visit to a Research Station for Horticulture. The 9 invited papers and their 9 reviews were presented in three sessions: geography, engineering, and land use. These 9 papers discuss topics of geology, land reclamation, soils, water management, drainage effects, urban land use, grasslands, dairy farm management, and horticulture of peat bogs. The two additional papers discuss horticulture and drainage. Four selected papers from the excursions discuss the geology of the deposits at the excavation Hazerswoude, vegetational development of a wood peat deposit, an experimental farm in Zegveld, and a research station in BosKoop. (See also W87-06623 thru W87-06637) (Geiger-PTT)
W87-06622

GEOLOGY OF THE HOLOCENE IN THE WESTERN PART OF THE NETHERLANDS,
Rijks Geologische Dienst, Haarlem (Netherlands).
For primary bibliographic entry see Field 2L.
W87-06623

SOILS AND THEIR GEOGRAPHY,
Stichting voor Bodemkartering, Wageningen (Netherlands).
For primary bibliographic entry see Field 2G.
W87-06627

WATER MANAGEMENT IN THE WESTERN NETHERLANDS,
Agricultural Univ., Wageningen (Netherlands).
For primary bibliographic entry see Field 4A.
W87-06628

WATER MANAGEMENT OF NORTHWESTERN GERMAN PEATLANDS,
Niedersaechsisches Landesamt fuer Bodenforschung, Bremen (Germany, F.R.). Bodentechnologisches Inst.
For primary bibliographic entry see Field 4A.
W87-06629

VEGETATIONAL DEVELOPMENT OF A WOOD PEAT DEPOSIT, AS READ FROM ITS POLLEN CONTENT,
Agricultural Univ., Wageningen (Netherlands).
For primary bibliographic entry see Field 2I.
W87-06637

2I. Water In Plants

GROWTH STATUS OF RHIZOBIA IN RELATION TO THEIR TOLERANCE TO LOW WATER ACTIVITIES AND DESICCATION STRESSES,
Lille-1 Univ., Villeneuve d'Ascq (France). Lab. de Microbiologie.
P. Mary, D. Ochin, and R. Tailliez.
Soil Biology and Biochemistry SBIOAH, Vol. 18, No. 2, p 179-184, 1986. 4 fig, 2 tab, 26 ref.

Descriptors: *Growth, *Rhizobium, *Nitrogen fixing bacteria, *Drying, *Water stress, *Microbiological studies, *Drought effects, Bacteria, Bacterial physiology, Stress, Solutes, Chlorides, Survival.

Two strains of Rhizobium meliloti and one of R. japonicum were grown in broth adjusted to selected water activities (a sub w) using KCl, NaCl, LiCl, or glycerol. Growth rates and yields decreased and lag times were lengthened as the a sub w was reduced below 0.99. The extent to which these responses changed depended on the solute used to lower the a sub w. Lag times were affected most when LiCl, NaCl, and KCl were used to lower a sub w below 0.9866. No growth occurred at a sub w 0.969 when NaCl or KCl were used, but consistent growth did occur at this a sub w when glycerol or LiCl were employed. In contrast with these results, LiCl was more toxic than NaCl for the slow-growing R. japonicum 5. This strain was susceptible to a sub w 0.9840 (glycerol). The growth stage of R. meliloti RCR 2011 affected the survival of this strain during storage at different relative humidity values. When subjected to drought stress, stationary phase cells survived better than cells collected at three different times during the exponential growth phase. (Author's abstract)
W87-06000

TOLERANCES OF SAGEBRUSH, RABBITBRUSH, AND GREASEWOOD TO ELEVATED WATER TABLES,
Agricultural Research Service, Burns, OR. Squaw Butte Station.
D. C. Ganskopp.
Journal of Range Management JRMGAQ, Vol. 39, No. 4, p 334-337, July 1986. 2 fig, 2 tab, 16 ref.

Descriptors: *Water table rise, *Sagebrush, *Rabbitbush, Tolerance, *Ecological distribution, *Phreatophytes, *Greasewood, Distribution patterns, Flooding, Water table, Water level, Topography, Weed control, Brush control.

The responses of Wyoming big sagebrush (Artemisia tridentata wyomingensis), green rabbitbrush (Chrysothamnus viscidiflorus), and black greasewood (Sarcobatus vermiculatus) to elevated water tables were studied on four contours bordering an expanding lake in southeast Oregon during the 1983 and 1984 growing seasons. When plants were initially selected for study, contours were 0, 10, 20, and 40 cm above the lake surface. Continued expansion of the lake flooded the lower contours and elevated the water tables under the upper contours. Wyoming big sagebrush rapidly succumbed to surface flooding and elevated water tables within 10 cm of the surface. Green rabbitbrush behaved similarly, but responses lagged about one week behind sagebrush. Black greasewood tolerated surface flooding for 40 days before effects were apparent. Water tables within 25 to 30 cm of the surface had no effect on greasewood. Given adequate topography and water supplies, water-spreading techniques could be used to control Wyoming big sagebrush and green rabbitbrush. (Author's abstract)
W87-06003

EFFECTS OF WATER APPLICATION RATES AND PLANTING DENSITY ON GROWTH PARAMETERS OF DRIP IRRIGATED ONIONS,
Puerto Rico Univ., Rio Piedras. Agricultural Experiment Station.
For primary bibliographic entry see Field 3F.
W87-06004

EXCRETION OF HEAVY METALS BY THE SALT MARSH CORD GRASS, SPARTINA AL-

TERNIFLORA, AND SPARTINA'S ROLE IN MERCURY CYCLING,
Rutgers - The State Univ., Piscataway, NJ. Dept. of Ecology.
For primary bibliographic entry see Field 5B.
W87-06069

PHOSPHATE DYNAMICS IN AN ACID SULFATE SOIL UNDER FLOODED CONDITION STUDIED BY A TRACER TECHNIQUE,
Royal Statistical Society, London (England).
For primary bibliographic entry see Field 5B.
W87-06185

CHEMICAL SPECIATION AND BIOAVAILABILITY OF COPPER: UPTAKE AND ACCUMULATION BY EICHORNIA,
Washington State Univ., Pullman. Dept. of Agronomy and Soils.
For primary bibliographic entry see Field 5B.
W87-06349

WHAT ARE THE LIMITS ON FOREST EVAPORATION - A FURTHER COMMENT,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2D.
W87-06376

STOCHASTIC MODEL OF RAINFALL INTERCEPTION,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2B.
W87-06379

MONO- AND DOUBLE-CROPPED WHEAT AND GRAIN SORGHUM UNDER RAINFED AND IRRIGATED CONDITIONS,
Sandyland Experiment Field, St. John, KS.
For primary bibliographic entry see Field 3F.
W87-06397

EFFECTS OF WATER DEFICITS ON YIELD, YIELD COMPONENTS, AND WATER USE EFFICIENCY OF IRRIGATED CORN,
Agricultural Research Service, Bushland, TX. Conservation and Production Lab.
For primary bibliographic entry see Field 3F.
W87-06398

EVALUATION OF POTENTIAL HERBIVORE MEDIATION OF PLANT WATER STATUS IN A NORTH AMERICAN MIXED-GRASS PRAIRIE,
Colorado State Univ., Fort Collins. Natural Resources Ecology Lab.
S. Archer, and J. K. Detling.
OIKOS OIKSAA, Vol. 47, No. 3, p 287-291, November 1986. 3 fig, 21 ref. NSF Grant DEB-80-22380.

Descriptors: *Leaves, *Water potential, *Plant water potential, *Grasslands, *Soil moisture, Precipitation, Prairie dogs, Herbivores, Grazing, Water stress.

Xylem water potentials (Psi) were monitored diurnally from June through August 1981 to ascertain the water status of plants of four species growing on a heavily grazed prairie dog colony and an adjacent lightly grazed uncolonized site in south western South Dakota. Highest Psi values were observed in June and August after periods of relatively high precipitation. Lowest values occurred in July when soil moisture was depleted. However, there were no large difference in Psi of grasses (Agropyron smithii, Andropogon geradi, and A. Scoparius) growing on and off the prairie dog colony, even though root biomass of plants on the colony was substantially lower. While midday leaf conductance was comparable for A. smithii tillers on and off the colony, conductance values for A. geradri and A. scoparius tillers were generally higher (17 to 60%) on the heavily grazed site. Artemisia frigida plants had slightly higher Psi on the prairie dog town during periods of moderate or high water stress. Soil moisture content was slightly but significantly higher on the heavily grazed prairie dog town, even though afternoon soil temperature at the 15 cm depth averaged 2.7 C higher. (Author's abstract)
W87-06403

INFLUENCE OF SOIL WATER STATUS ON THE EPIDEMIOLOGY OF TOBACCO BLACK SHANK,
Florida Univ., Gainesville. Dept. of Plant Pathology.
For primary bibliographic entry see Field 2G.
W87-06405

SOME EFFECTS OF WATER POTENTIAL ON GROWTH, TURGOR, AND RESPIRATION OF PHYTOPHTHORA CRYPTOGEA AND FUSARIUM MONILIFORME,
California Univ., Davis. Dept. of Plant Pathology.
D. M. Woods, and J. M. Duniway.
Phytopathology PHYTAJ, Vol. 76, No. 11, p 1248-1254, November 1986. 3 fig, 2 tab, 29 ref.

Descriptors: Descriptors, *Plant growth, *Plant water potential, *Water potentials, *Plant growth substances, *Plant physiology, *Turgor, *Respiration, Solutes, Culture media, Growth media, Agars, Nutrition, Metabolism.

Mycelial growth, turgor, and respiration of Phytophthora cryptogea and Fusarium moniliforme were evaluated in media adjusted to various constant water potentials (Psi) by adding solutes. Growth by P. cryptogea in standing liquid cultures was reduced by 50% at -9 to -31 bars Psi, whereas a 50% reduction in the growth of F. moniliforme occurred at -26 to -200 bars, the exact values depending on the medium and solutes used to vary Psi. Growth measured in fresh weight was generally decreased more by decreases in Psi than was growth in dry weight. Whereas P. cryptogea grew at lower Psi values in a complex liquid medium of high nutritional content than in a defined medium, F. moniliforme gave the opposite results. Use of agar rather than liquid medium extended the Psi range over which P. cryptogea grew. Mycelial turgor in P. cryptogea, as estimated with thermocouple psychrometers, gradually increased from 12 to 25 bars as medium Psi was decreased from -5 to -24 bars, even though the same decreases in Psi reduced growth. F. moniliforme maintained turgor pressures that averaged 15 bars over the entire Psi range of -5 to -200 bars that allowed measurable growth. Respiration rates were significantly higher for mycelial mats grown at low Psi values, and respiration rates of P. cryptogea increased proportionately more than did those of F. moniliforme as Psi decreased. The results suggest that the metabolic costs of growth at low Psi values influence growth rate more than does turgor pressure and are more limiting for P. cryptogea than for F. moniliforme. (Author's abstract)
W87-06406

DIFFERENTIAL MRNA TRANSCRIPTION DURING SALINITY STRESS IN BARLEY,
Science and Education Administration, Albany, CA. Western Regional Research Center.
For primary bibliographic entry see Field 3C.
W87-06407

GENE INDUCTION AND REPkESSION BY SALT TREATMENT IN ROOTS OF THE SALINITY-SENSITIVE CHINESE SPRING WHEAT AND THE SALINITY-TOLERANT CHINESE SPRING X ELYTRIGIA ELONGATA AMPHIPLOID,
California Univ., Davis. Dept. of Agronomy and Range Science.
For primary bibliographic entry see Field 3C.
W87-06408

ENVIRONMENTAL CONTAMINATION BY LEAD AND CADMIUM IN PLANTS FROM URBAN AREA OF MADRID, SPAIN,
Consejo Superior de Investigaciones Cientificas, Madrid (Spain). Inst. de Quimica Organica General.
For primary bibliographic entry see Field 5A.
W87-06420

EFFECT OF INCREASING COPPER AND SALINITY ON GLYCEROL PRODUCTION BY DUNALIELLA SALINA,
Montclair State Coll., Upper Montclair, NJ. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W87-06431

SOIL WATER STATUS AFFECTS THE STOMATAL CONDUCTANCE OF FULLY TURGID WHEAT AND SUNFLOWER LEAVES,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.
T. Gollan, J. B. Passioura, and R. Munns.
Australian Journal of Plant Physiology AJPPCH, Vol. 13, No. 4, p 459-464, July 1986. 4 fig, 10 ref. Deutsche Forschungsgemeinschaft SFB 137.

Descriptors: *Stomatal conductance, *Soil water, *Soil-water-plant relationships, *Wheat, *Sunflowers, *Leaves, Turgidity, Water pressure, Plant physiology, Plant tissues, Stomata, Conductance, Roots.

Wheat and sunflower were grown in pots that could be enclosed in a pressure chamber, with the shoot in a cuvette. Applying an appropriate pneumatic pressure to the roots enabled the leaves to be kept fully turgid despite any drying of the soil. The leaf conductance of plants was followed while the soil dried. Remarkably, this conductance fell with falling soil water content no matter whether the leaves were kept turgid or not. It was concluded that the roots sensed the drying of the soil and sent a message to the leaves which induced stomatal closure. (Author's abstract)
W87-06530

GLAUCOUSNESS IN WHEAT: ITS DEVELOPMENT AND EFFECT ON WATER-USE EFFICIENCY, GAS EXCHANGE AND PHOTOSYNTHETIC TISSUE TEMPERATURES,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.
R. A. Richards, H. M. Rawson, and D. A. Johnson.
Australian Journal of Plant Physiology AJPPCH, Vol. 13, No. 4, p 465-473, July 1986. 2 fig, 4 tab, 17 ref.

Descriptors: *Plant physiology, *Glaucousness, *Water use efficiency, *Wheat, *Crop yield, *Drought effects, Epicuticular wax, Plant tissues, Dry matter, Leaves, Irrigation effects, Photosynthesis, Temperature control, Temperature, Transpiration, Stomata, Stomatal transpiration.

Glaucousness, which is the visual manifestation of epicuticular wax, was previously found to increase the yield of grain and dry matter of droughted wheat. The development of epicuticular wax in a pair of durum (Triticum turgidum L. var. durum) wheats isogenic for glaucousness and the likely reasons for increased yields of glaucous durum and common (T. aestivum L.) wheats over their non-glaucous isogenic counterparts were studied. Glaucousness first appears on the leaf sheath at the time of stem elongation. It rapidly reaches maximum expression, particularly on the flag leaf sheath and the adaxial surface of the flag leaf lamina, as well as on the emerging head. In glasshouse experiments using isogenic pairs of both common and durum wheats, the water-use efficiency measured between sowing and maturity in droughted treatments was on average 9% higher in the glaucous lines. Glaucous leaves were retained longer than non-glaucous leaves in the droughted treatment but not in the irrigated control. In droughted field-grown plants, temperatures of photosynthetic tissues were up to 0.7 C cooler in glaucous than non-glaucous lines, depending on the time of day. Similarly, in well-watered glasshouse plants, glaucous plant parts were on average 0.3 C cooler than non-glaucous plants. Gas-exchange studies of the

durum lines in both irrigated and droughted treatments in a glasshouse indicated that ears of non-glaucous plants had higher rates of photosynthesis and day- and night-time transpiration, a higher stomatal conductance and a greater rate of increase in photosynthesis with increasing light levels. However, the ratio of photosynthesis to transpiration was higher in the ears of glaucous plants. No differences were found for flag leaves when the adaxial surface was exposed to light. It was determined that glaucousness can be a positive character under water-limited conditions, primarily through its effect of water-use efficiency, on an extended period of transpiration and on the timing of the deposition of wax. (Author's abstract)
W87-06531

GAS EXCHANGE AND GROWTH IN WHEAT AND BARLEY GROWN IN SALT,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.
H. M. Rawson.
Australian Journal of Plant Physiology AJPPCH, Vol. 13, No. 4, p 475-489, July 1986. 6 fig, 4 tab, 28 ref.

Descriptors: *Plant growth, *Saline water, *Salinity, *Water pollution effects, *Salt tolerance, *Wheat, *Barley, *Impaired water use, Water use efficiency, Sodium chloride, Leaves, Plant tissues, Photosynthesis, Grain crops, Lethal limit, Mortality, Hydrologic budget, Ions, Comparison studies, Bioindicators, Indicators.

By measuring a range of gas exchange and growth variables, attempts were made to select key indicators of response to salinity in a wheat (Q61) and a barley (Beecher). A second wheat (WW15, Anza) was included in the growth measurements. Plants were grown to anthesis in gravel culture flushed with 0, 75, or 150 mol/cu m NaCl, and under the high radiation and evaporative conditions of summer. Salinity increased leaf chloride contents and reduced peak photosynthesis, the initial slope of the light response curves, and dark respiration of young leaves at ligule emergence, but dark respiration of slightly older leaves was increased by salinity as were the CO2 compensation points. Short-duration changes on salinity could modify photosynthesis rates by no more than 15% though dark respiration rates moved quickly towards those of plants held continuously at the new salinity level. While Q61 wheat appeared superior to Beecher barley at moderate salinity using these gas exchange indicators, it died at 150 mol/cu m NaCl; Beecher and WW15 survived. Carbon and water budgets are used to propose that the demise of Q61 could have been partially due to its marginally poorer water-use efficiency and its higher specific leaf weight, i.e. its higher requirement for carbon and water to produce each unit area of leaf. It was suggested that measurements of relative leaf expansion rate, specific leaf weight, and water-use efficiency are basic requirements in a salinity screening program. Measurements of ion contents and gas exchange variables are of little benefit when used alone. (Author's abstract)
W87-06532

DIFFERENTIAL EFFECTS OF K(+) AND NA(+) ON OXYGEN EVOLUTION ACTIVITY OF PHOTOSYNTHETIC MEMBRANES FROM TWO HALOPHYTES AND SPINACH,
Australian National Univ., Canberra. Dept. of Botany.
C. Preston, and C. Critchley.
Australian Journal of Plant Physiology AJPPCH, Vol. 13, No. 4, p 491-498, July 1986. 7 fig, 1 tab, 29 ref.

Descriptors: *Plant physiology, *Halophytes, *Spinach, *Plant tissues, *Aqua culture, *Photosynthesis, *Biological membranes, *Water pollution effects, *Salt tolerance, Ions, Potassium, Sodium, Membranes, Biological oxygen demand, Salts.

KCl reduced oxygen evolution by Sarcocornia quinqueflora thylakoids to well below the level of activity in the presence of NaCl. This inhibition occurred at both high and low pH. On the other hand, both KCl and NaCl induced almost indistinguishable effects on oxygen evolution in spinach thylakoids. Photosystem (PS) II membranes from Avicennia marina showed a similar inhibition of oxygen evolution by KCl to S. quinqueflora thylakoids, but spinach PS II particles were not inhibited by KCl. The KCl inhibition of oxygen evolution of halophytic thylakoids was localized to the oxygen-evolving complex and required little KCl, as significant inhibition occurred with only 25 mM. K2SO4 was also inhibitory, but Na2SO4 was not, indicating the K(+) was in the inhibitory ion. Na2SO4 was partly able to reverse the inhibition caused by KCl, suggesting the inhibition to be a function of the K(+)/Na(+) ratio. These results have implications concerning the ionic relations of the leaf cells of halophytes. (Author's abstract)
W87-06533

EFFECT OF WATER STRESS ON NITROGEN NUTRITION OF GRAIN SORGHUM,
Queensland Univ., Brisbane (Australia). Dept. of Agriculture.
T. J. Rego, N. J. Grundon, C. J. Asher, and D. G. Edwards.
Australian Journal of Plant Physiology AJPPCH, Vol. 13, No. 4, p 499-508, July 1986. 3 fig, 6 tab, 15 ref.

Descriptors: *Plant growth, *Nitrogen, *Nutrients, *Water stress, *Sorghum, *Osmotic pressure, Plant tissues, Stress, Grain crops, Dry matter, Crop yields, Leaves, Roots, Bioaccumulation.

A solution culture experiment was conducted to study the effects of solution osmotic potential and nitrogen (N) supply on growth and N content of grain sorghum cv. Texas 6l0SR. Polyethylene glycol-6000 was used to impose solution osmotic potentials of -0.1, -0.4, -0.8, and -1.1 MPa during the fourth week of growth. Plants were harvested at 6 weeks. Dry matter yields, total plant N content and mean rate of N uptake per unit root weight were significantly decreased by decreases in solution osmotic potential and N supply. Numbers of leaves expanded after imposition of the solution osmotic potential treatments were also reduced significantly by decreasing solution osmotic potential and decreasing N supply. Decreasing solution osmotic potential decreased mean N concentrations in leaves, had no effect on mean N concentration in roots, and increased N concentrations in stems plus immature leaves, and in whole tops. The form of relationships between leaf N concentration and yield prevented the calculation of critical N concentrations at any level of solution osmotic potential. (Author's abstract)
W87-06534

USE OF CONCENTRATED MACRONUTRIENT SOLUTIONS TO SEPARATE OSMOTIC FROM NACL-SPECIFIC EFFECTS ON PLANT GROWTH,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.
A. Termaat, and R. Munns.
Australian Journal of Plant Physiology AJPPCH, Vol. 13, No. 4, p 509-522, July 1986. 7 fig, 3 tab, 32 ref.

Descriptors: *Plant growth, *Osmotic pressure, *Sodium chloride, *Salinity, *Salt tolerance, *Macronutrient solutions, *Solute transport, *Water pollution effects, *Impaired water use, *Ion transport, Ions, Nutrients, Barley, Wheat, Clovers, Roots, Nitrogen, Plant tissues, Bioaccumulation.

Osmotic and ion-specific effects of NaCl on plant growth and ion uptake were distinguished by comparing plants grown in isosmotic solutions with and without NaCl. Preliminary experiments showed that polyethylene glycol 4000 and mannitol were unsuitable for even very-short-term studies because they caused immediate reductions in leaf elongation rate when plants were transferred from NaCl to isosmotic solutions of these compounds. However, concentrated solutions of macronutrients (modified Hoagland's nutrients) did not change the elongation rate. Barley, wheat, Egyptian clover and white clover were grown in NaCl and concentrated macronutrient solutions of matching osmotic pressures. After 14 days, plants grown in concentrated macronutrients were smaller than controls (plants in normal strength nutrient solution), but had similar root:shoot ratios. NaCl-grown plants were less than half the size of plants in concentrated macronutrients, and had higher root:shoot ratios. NaCl induced phosphate uptake did not cause this additional reduction in shoot growth. For barley, net transport of K(+), Mg(2+), Ca(2+) and total nitrogen from the roots (per gram root dry weight) was lower in NaCl-grown plants than in controls, but uptake by the shoot (per gram shoot dry weight) of these minerals was similar. By contrast, both transport and uptake of these minerals in concentrated macronutrient-grown plants resembled control plants. NaCl-grown barley and wheat plants had higher osmotic pressures in both growing and mature tissue than did controls and macronutrient-grown plants, but a lower rate of uptake of solutes generating this osmotic pressure. The possibility that growth in NaCl may be limited by a reduced rate of transport of an essential nutrient to the shoot was raised. (Author's abstract)
W87-06535

WATER USE, GRAIN YIELD AND OSMOREGULATION IN WHEAT,
New South Wales Dept. of Agriculture, Tamworth (Australia). Agricultural Research Centre.
J. M. Morgan, and A. G. Condon.
Australian Journal of Plant Physiology AJPPCH, Vol. 13, No. 4, p 523-532, July 1986. 4 fig, 4 tab, 14 ref.

Descriptors: *Plant growth, *Water use efficiency, *Water use, *Wheat, *Osmoregulation, *Osmotic pressure, *Turgidity, *Crop yield, Grain crops, Water deficit, Soil water, Turgor maintenance, Surface water, Mathematical equations.

Genotypic differences in turgor maintenance in wheat were shown to be associated with differences in grain yield in the field at both high and low water deficits. High water deficits were produced by growing plants in pots using water stored in the soil at sowing, and excluding rain with a rain cover. At low water deficits plants received rainfall, and irrigation was supplied before and immediately after sowing, at tillering, at jointing, at ear emergence, and during grain filling. Yield differences were analyzed in terms of harvest index, water use and water use efficiency. Water use was calculated from changes in soil water contents. At high water deficits all three factors were associated with differences in turgor maintenance. However, only the variations in water use and harvest index could be logically associated with differences in turgor maintenance. Analysis of the soil water extraction data showed that the differences in water use efficiency were solely due to differences in water use at depth while surface water losses were the same, i.e. the ratio of transpiration to soil evaporation would have been higher in low-osmoregulating genotypes. At low water deficits, no differences were observed in harvest index, though there were non-significant correlations between turgor maintenance and total water use efficiency or total water use. A similar result was obtained when water use and yield data were related to osmoregulation measurements made in the glasshouse. It was therefore concluded that effects of turgor maintenance or osmoregulation on grain yield were primarily associated with differences in water use which were, in turn, due to differences in water extraction at soil depths between 25 and 150 cm. (Author's abstract)
W87-06536

ION REGULATION IN THE ORGANS OF CASUARINA SPECIES DIFFERING IN SALT TOLERANCE,
Australian National Univ., Canberra. Dept. of Forestry.
N. Aswathappa, and E. P. Bachelard.
Australian Journal of Plant Physiology AJPPCH, Vol. 13, No. 4, p 533-545, July 1986. 5 fig, 6 tab, 18 ref.

Descriptors: *Plant physiology, *Plant tissues, *Ion regulation, *Salt tolerance, *Water pollution effects, *Impaired water use, Ion transport, Sodium, Chlorides, Calcium, Magnesium, Seedlings, Ions, Sodium chloride, Salinity, Roots, Bioaccumulation.

Distribution of Na(+), Cl(-), K(+), Ca(2+) and Mg(2+) was studied in individual organs of two highly tolerant and one moderately tolerant species of Casuarina. The highly tolerant species (C. equisetifolia and C. glauca) accumulated little Na(+) and Cl(-) in their shoots and the concentrations of Na(+) and Cl(-) decreased from old to young growing needles. The concentrations of Na(+) and Cl(-) were much higher in shoots of the moderately tolerant species (C. cunninghamiana) and a concentration gradient between old and young needles was not observed. The same pattern of distribution of Cl(-) in C. equisetifolia was found in seedlings exposed to both short term (13 days at 100 mol/cu m NaCl in solution culture), and long term (6 months at 250 mol/cu m NaCl in sand culture) salinization. The three species showed little difference in their root ion concentrations. A time sequence experiment of Cl(-) uptake indicated that the better exclusion of Cl(-) from the shoots of C. equisetifolia than C. cunninghamiana was due to a lower rate of Cl(-) uptake and lower net transport into the shoot rather than to its retention in the roots, or reabsorption at the proximal root or hypocotyl. (Author's abstract)
W87-06537

REDUCTION BY GA3 OF NACL-INDUCED INHIBITION OF GROWTH AND DEVELOPMENT IN SUAEDA USSURIENSIS,
Qufu Teachers Univ. (China). Dept. of Biology.
K.-F. Zhao, M.-L. Li, and J.-Y. Liu.
Australian Journal of Plant Physiology AJPPCH, Vol. 13, No. 4, p 547-551, July 1986. 2 tab, 25 ref.

Descriptors: *Plant growth, *Impaired water use, *Halophytes, *Salt tolerance, *Gibberellic acid, *Phytohormones, *Sodium chloride, *Growth rates, *Water pollution effects, Seedlings, Saline soils, Mortality, Lethal limit, Salts.

The counteraction by the phytohormone gibberellic acid (GA3) of inhibition caused by salinity during the growth and development of the halophyte Suaeda ussuriensis was reported. Seedlings of S. ussuriensis were grown in soil with NaCl concentrations of 0.5, 1.0, 2.0 and 3.0% on a dry weight basis. The optimum salt concentration for growth and development was 1.0%. At 3.0% all seedlings died. Treatment with 100000 micrograms/liter GA3 partly counteracted the growth inhibition, and the dry weight of the plants increased 21.6, 2.2, and 19.4%, respectively, for soils with salt concentrations of 0.5, 1.0, and 2.0%. GA3 increased the number of plants coming to flower in soil of salt concentrations of 0.5 and 2.0% by 40 and 20%, respectively, but had no effect on plant growth in a salt concentration of 1.0%. (Wood-PTT)
W87-06538

ROLE OF LEAF AREA DEVELOPMENT AND PHOTOSYNTHETIC CAPACITY IN DETERMINING GROWTH OF KENAF UNDER MODERATE SALT STRESS,
California Univ., Davis. Dept. of Land, Air and Water Resources.
P. S. Curtis, and A. Lauchli.
Australian Journal of Plant Physiology AJPPCH, Vol. 13, No. 4, p 553-565, July 1986. 5 fig, 3 tab, 53 ref. Regional Project W-157.

Descriptors: *Plant growth, *Salt tolerance, *Leaves, *Photosynthesis, *Kenaf, *Water pollution effects, *Impaired water use, Sodium chloride, Salts, Saline water, Salinity, Carbon dioxide, Fiber crops, Plant fibers, Osmotic pressure, Salt balance, Crop yield.

Growth, net CO2 exchange rate and plant water relations were analyzed in kenaf (Hibiscus cannabinus) cv. Cuba-108, a stem fiber crop, grown at 1, 37 and 75 mM NaCl. Dry weight was reduced only at 75 mM NaCl although leaf area was affected at both 37 and 75 mM NaCl. Growth analysis following nine serial harvests over 40 days showed a significant decline in leaf area ratio with salt stress, but no decrease in net assimilation rate. CO2 exchange rate, measured on recently expanded leaves by infrared gas analysis, increased in plants grown at 37 mM NaCl and was unchanged at 75 mM NaCl. Pressure-volume analysis of plant water relations showed an osmotic adjustment of 0.15 MPa in plants grown at 75 mM but no adjustment at 37 mM NaCl. Turgor potential declined in plants grown at either salt level and fell to near zero during midday. It was concluded that growth in kenaf under moderate salt stress is affected primarily through a reduction in expansive growth and leaf area development rather than a decline in photosynthetic capacity. (Author's abstract)
W87-06539

SHOOT AND ROOT RESPONSE TO WATER DEFICITS IN RAINFED LOWLAND RICE,
International Rice Research Inst., Los Banos, Laguna (Philippines). Dept. of Agronomy.
R. T. Cruz, J. C. O'Toole, M. Dingkuhn, E. B. Yambao, and M. Thangaraj.
Australian Journal of Plant Physiology AJPPCH, Vol. 13, No. 4, p 567-575, July 1986. 6 fig, 1 tab, 18 ref.

Descriptors: *Plant growth, *Water deficit, *Rice, *Soil moisture, *Roots, *Soil-water-plant relationships, *Shoots, *Water stress, Field tests, Plant tissues, Sprinkler irrigation, Leaves, Canopy, Photosynthesis, Nitrogen, Dry matter, Grain crops, Crop yield.

A field study was conducted to determine the response of the rice cultivar IR54 to a gradient of soil moisture conditions imposed for 19 days at the vegetative stage using a line source sprinkler system. A mild plant water stress at the vegetative growth stage decreased tiller number, leaf area index (LAI), apparent canopy photosynthetic rates, leaf nitrogen per unit land area, shoot and total root dry mass, and total root density. After complete stress relief by reflooding, LAI and crop growth remained below that of unstressed plants. The lower cumulative assimilation per unit land area in the stressed treatments resulted in reduced shoot and root dry matter yields and lower grain yields. Water stress increased the ratio of shoot dry mass to root dry mass, and the ratio of leaf area to total root length. The decrease in root length was attributed to increased soil mechanical impedance. (Author's abstract)
W87-06540

INFLUENCE OF MYRIOPHYLLUM SPICATUM L. ON THE SPECIES COMPOSITION, BIOMASS AND PRIMARY PRODUCTIVITY OF PHYTOPLANKTON,
Quebec Univ., Montreal. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2H.
W87-06595

VARIATIONS IN LEAF CHARACTERISTICS OF SIX SPECIES OF SAGITTARIA (ALISMATACEAE) CAUSED BY VARIOUS WATER LEVELS,
University of Southern Mississippi, Hattiesburg. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W87-06597

GAS EXCHANGE OF TYPHA ORIENTALIS PRESL. COMMUNITIES IN ARTIFICIAL PONDS,
Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Centre for Irrigation Research.
For primary bibliographic entry see Field 2H.
W87-06598

ALGICIDAL PROPERTIES OF ACACIA NILOTICA,
Agricultural Research Council, Khartoum (Sudan). Dept. of Phytochemistry.
For primary bibliographic entry see Field 4A.
W87-06599

VEGETATION DYNAMICS IN TEMPORARY AND SHALLOW FRESHWATER HABITATS,
Rajasthan Univ., Jaipur (India). Dept. of Botany.
For primary bibliographic entry see Field 2H.
W87-06600

STRATEGY FOR CONCURRENTLY MONITORING THE PLANT WATER POTENTIALS OF SPATIALLY SEPARATED FOREST ECOSYSTEMS,
Alberta Univ., Edmonton. Dept. of Botany.
For primary bibliographic entry see Field 7A.
W87-06603

INLAND SPRUCE CONE RUST (CHRYSOMYXA PIROLATA) CONTROL: RELATION OF FERBAM APPLICATION TO BASIDIOSPORE PRODUCTION, RAINFALL, AND CONE PHENOLOGY,
British Columbia Ministry of Forests, Victoria. Silviculture Branch.
D. Summers, J. R. Sutherland, and T. A. D. Woods.
Canadian Journal of Forest Research CJFRAR, Vol. 16, No. 2, p 360-362, April 1986. 2 fig, 10 ref.

Descriptors: *Spruce cone rust, *Ferbam, *Basidiospore production, *Plant disease control, *Rainfall, *Precipitation, *Cone phenology, Salmon Arm, British Columbia, Trees, Pollination, Seed yield, Seed germination, Forestery, Fungicides, White spruce trees.

Experiments were conducted over a 3-year period (1982-1984) at a white spruce seed orchard near Salmon Arm, British Columbia, to relate the control of inland spruce cone rust by ferbam to the number of fungicide applications, basidiospore production, rainfall, and cone phenology. Although the effect of rainfall or moisture is not known, rainfall during the pollination-spore liberation period did not appear to be related to disease absence. Either multiple or single applications of ferbam were sprayed on the cone-bearing portion of each tree during the period starting about 1 week before and through the pollination period. These applications reduced the incidence of spruce cone rust by 5- to 10-fold without any reduction in seed yield per cone, although seed germination was reduced slightly. Single applications of the fungicide protected cones even when rainfall preceded or followed application. (Author's abstract)
W87-06604

DRAINAGE AND BEHAVIOUR OF PEAT SOILS,
Instituut voor Cultuurtechniek en Waterhuishouding, Wageningen (Netherlands).
For primary bibliographic entry see Field 4A.
W87-06630

USE OF PEAT SOILS FOR GRASSLAND,
Centre for Agrobiological Research, Wageningen (Netherlands).
For primary bibliographic entry see Field 4A.
W87-06632

FARM MANAGEMENT ON PEAT SOILS,
Advisory Service for Matters Relating to Soil Science in Agriculture, Wageningen (Netherlands).
For primary bibliographic entry see Field 4A.
W87-06633

USE OF PEAT AND PEAT SOILS FOR HORTICULTURE,
Advisory Service for Soils and Fertilizers in Horticulture, Wageningen (Netherlands).
A. P. Hidding.
IN: Proceedings of the Symposium on Peat Lands Below Sea Level, August 24-28, 1981, The Netherlands. IRLI Publication No. 30, 1982. p 248-255, 1 fig, 2 tab, 7 ref.

Descriptors: *Horticulture, *Soil water, *Soil-water-plant relationships, *Peat soils, *Land use, Surface drainage, Land reclamation, Peat bogs, Soil types, Sand, Water table, Peat, Plant growth, Topsoil, Moisture tension, Drainage ditches.

The workability, high pore space, and available water of peat soils makes them favorable for horticultural use. An intensive horticulture industry has developed around Leiden, Haarlem and Amsterdam in the western Netherlands. Most of these soils consist of a subsoil of sedge peat or wood peat, covered with a toplayer of decomposed peat mixed with clay or sand. The groundwater table must be kept high to prevent the peat from shrinking and oxidizing. A restricted distance between drainage ditches is necessary to keep the groundwater level within narrow boundaries. Today the horticultural area has extended from the peat uplands into the polders on the drained lake bottoms. The large modern flower farms are found on the loamy soils of the former bog floors. The need for stronger heating on peat soils is caused by a high heat conductivity, resulting in a higher value of the thermal diffusivity. Sterilization of peat soils between two growing periods is also a problem. Steaming may cause structural damage and the use of methyl bromide is now forbidden. Since the wood peat has a high water permeability, water supply by subirrigation is possible. Subsurface drainage is preferable with a closed system of tiles ending in a pit with a pump to control the water table level independently from the ditch. Subsidence may be more severe in horticultural lands than in grasslands due to the removal of topsoil with root balls without sufficient replenishment with other materials. Topsoil is now mixed with dune sand to improve workability and soil structure. Other materials such as heather, grasses and sand are being tried as substitutes for dune sand. Peat moss mixed with half-decomposed peat, clay and mud is pressed into blocks for the growth of seedlings of lettuce, tomatoes and cucumbers. (See also W87-06622) (Geiger-PTT)
W87-06634

VEGETATIONAL DEVELOPMENT OF A WOOD PEAT DEPOSIT, AS READ FROM ITS POLLEN CONTENT,
Agricultural Univ., Wageningen (Netherlands).
A. J. Havinga, and R. M. van den Berg van Saparoea.
IN: Proceedings of the Symposium on Peat Lands Below Sea Level, August 24-28, 1981, The Netherlands. IRLI Publication No. 30, 1982. p 275-281, 2 fig, 4 ref.

Descriptors: *Pollen, *Peat bogs, *Palynology, *Vegetation, *Peat soils, Peat, Species composition, Species diversity, Land reclamation, Sand, Clay, Trees, Grasses, Plant populations, Fens, Levees.

At a levee excavation site near the village of Hazerswoude, peat soil was investigated by pollen analysis to show how the various plant species contributed to the formation of the peat deposit. The pollen diagram can be divided horizontally into three sections: 265-253 cm, coinciding with the top of the old marine Calais III deposit at the base of the peat; 253-247 cm, comprising the total depth of the undisturbed peat deposit; and 47-35 cm, coinciding with a thin layer at the top of the peat deposit, where the peaty material is mixed with sandy material and some shards from the overlying bed of man-made soil. In the bottom section, the percentages of the various tree pollen types are not representative of the vegetation in the environs of the sampling site; the Pinus pollen is over-represented and the high Corylus and Quercus values are probably due to pollen supplied from a secondary source such as the forests on the levees along the Oude Rijn river. In the undisturbed peat, the pollen spectra have a high non-tree/tree ratio, reflecting a dense and extensive vegetation of grasses, sedges and ferns. The upper part of the peat deposit consists of a more clayey wood peat. The varying composition of the successive pollen assemblages parallels the change in vegetative remains; the non-tree/tree ratio decreases considerably above the reed-sedge peat while further up the diagram the Alnus percentages reach very high values. In the short top section of the diagram the total tree pollen falls sharply and finally cereals appear for the first time. The pollen spectra here represents the Sub-Atlantic period when the more Eutrophic fen-peat soils were reclaimed for farmland. The present pollen diagram shows some similarities to those of De Jong's for a fill of a fossil river gully containing wood peat and a pure alder-carr peat soil at some distance from the levee. (See also W87-06622) (Geiger-PTT)
W87-06637

2J. Erosion and Sedimentation

MUD ACCUMULATION IN ESTUARINE CHANNELS - A QUESTION OF DREDGING,
Institut fuer Meeresforschung, Bremerhaven (Germany, F.R.).
S. Wellershaus.
Environmental Technology Letters ETLEDB, Vol. 7, No. 5, p 255-262, May 1986. 4 fig, 2 tab, 20 ref. Federal Ministry of Research and Technology (Germany, F.R.) Project MFU 0505 D.

Descriptors: *Dredging, *Estuarine environment, *Sedimentation, *Germany, *Tidal currents, Turbidity, Mud, Channels, Sediment erosion, Elbe River, Weser River, Estuaries.

For two coastal plain estuaries, the Elbe and the Weser (Germany, F. R.), hydrographic data and depth maps (170 yr old and recent) were used to test the hypothesis that overdeepening by dredging causes mud trapping in the estuarine channel. The data examined indicate that it is most probable that an important cause of accumulation of mud sediments in the salt wedge area of estuarine channels is overdeepening of the channel by dredging. A trap is formed for light-weight particles collected from suspension. These particles form the source of the mud, which is temporarily re-eroded and re-suspended by tidal currents and forms a turbidity cloud. Although the present interpretation is regarded as the most likely one, it is not considered absolute. (Rochester-PTT)
W87-05949

COPING WITH ACCELERATED SOIL EROSION IN NIGERIA,
Jos Univ. (Nigeria). Dept. of Agricultural Engineering.
D. O. Aneke.
Journal of Soil and Water Conservation JSWCA3, Vol. 41, No. 3, 161-163, May-June 1986.

Descriptors: *Soil erosion, *Nigeria, Farming methods, Farm mechanization, Desert encroachment, Wind erosion, Ecomomic aspects, Soil conservation, Ecological systems, Population density, Food shortages.

Six ecological systems occur in Nigeria. The population is estimated at 100 million. Despite a large farm population, there are continued food shortages. Soil productivity declines due to erosion are clearly evident. Historically, Nigerian farmers have solved soil erosion problems by abandoning the land. Accelerated erosion is caused by human's continued attempts to create a higher quality of life. Several factors contribute to accelerated erosion: sociological factors, farming systems, tillage and farm mechanization, and wind erosion and desert encroachment. Soil erosion is dangerous; it reduces soil fertility and productivity. Tons of valuable, rich topsoil are lost annually to the national drainage system. Officials estimate that control of identified gullies would cost about $2.2 billion (U.S.). Essential steps that must be taken include: adequate soil conservation measures prior to land clearing; scientific farming systems; and integrated watershed development schemes. Although more needs to be done to bring erosion under control, the impact of current government action is being felt. (Main-PTT)
W87-05963

ESTIMATING THE TOPOGRAPHIC FACTOR IN THE UNIVERSAL SOIL LOSS EQUATION FOR WATERSHEDS,
Montana State Univ., Bozeman. Dept. of Earth Sciences.
J. P. Wilson.
Journal of Soil and Water Conservation JSWCA3, Vol. 41, No. 3, 179-184, May-June 1986. 5 fig, 13 ref.

Descriptors: *Soil loss equation, *Statistical anslysis, *Slope profiles, *Erosion, *Watersheds, *Groundwater, Topographic maps, Land slopes, Soil water loss, Soil loss, Mathematical studies.

A new, objective approach for estimating slope gradient and slope length frequency distributions for watersheds using topographic maps and Grenville's spline function is described. Statistical analyses of slope segments and estimation of LS values for irregular slopes are used to analyze the computer-generated slope profiles and to produce the final LS values. The method was applied to 30 profiles in Ontario's Lovers Creek watershed. Slope gradients and lengths also were measured in the field. Results of estimated values were compared with measured values to show the accuracy of the new method and the significance of the scale and contour interval of topographic maps. The approach has several strengths: it is objective; the analysis can be carried out quickly and inexpensively by computer; and the output is consistent with the original USLE definitions for the slope parameters. Most important the method produces frequency distributions of slope gradients, slope length, and LS values. (Main-PTT)
W87-05965

REDUCING SOIL EROSION IN TOBACCO FIELDS WITH NO-TILLAGE TRANSPLANTING,
North Carolina Dept. of Natural Resources and Community Development, Wilmington.
S. D. Wood, and A. D. Worsham.
Journal of Soil and Water Conservation JSWCA3, Vol. 41, No. 3, 193-196, May-June 1986. 4 fig, 3 tab, 16 ref.

Descriptors: *Erosion, *Tillage effects, *Crop yield, *Soil erosion, *Tobacco farming, *No-tillage transplanting, *North Carolina, Land slope, Agriculture, Soil loss tolerances, Soil types, Loam, Productivity.

While important crops in the Southeast, flue-cured and burley tobacco are erosion-prone. Soil losses from tobacco fields far exceed the state and national averages as well as soil loss tolerances. A 2-year study was conducted in North Carolina's Coastal Plain to compare soil loss, yield, and quality between conventionally tilled tobacco and no-till tobacco transplanted directly into a tilled rye mulch. In the first year soil loss on a Johns sandy loam with 1.3% slope was 20 times greater in the conventionally tilled tobacco than in the no-till tobacco. Soil loss the second year on a Goldsboro loamy sand with a 3.1% slope was 90 times greater in the conventional tillage system. Quality, value per hectar, and price of tobacco were essentially the same for both systems. But yields on no-till transplanted treatments averaged 13% less than conventionally grown tobacco. (Author's abstract)
W87-05967

HYDROCARBON POLLUTION FROM MARINAS IN ESTUARINE SEDIMENTS,
Virginia Inst. of Marine Science, Gloucester Point.
For primary bibliographic entry see Field 5B.
W87-05969

MODELLING COHESIVE SEDIMENT TRANSPORT IN ESTUARIAL WATERS,
E. J. Hayter, and A. J. Mehta.
Applied Mathematical Modelling AMMODL, Vol. 10, No. 4, p 294-303, August 1986. 12 fig, 27 ref. NOAA Project RIC-6.

Descriptors: *Model studies, *Sediment transport, *Path of pollutants, *Estuaries, *Water pollution, *Dredging, *Cohesive soils, Marine sediments, Finite element method.

Cohesive sediment related problems in estuaries include shoaling in navigable waterways and water pollution. A two-dimensional, depth-averaged, finite element (FE) cohesive sediment transport model, CSTM-H, was developed and may be used to assist in predicting the frequency and quantity of dredging required to maintain navigable depths and the fate of adsorbed pollutants. Algorithms which describe the processes of erosion, dispersive transport, deposition, bed formation and bed consolidation are incorporatedin CSTM-H. The Galerkin weighted residual method is used to solve the advection-dispersion equation with appropriate source/sink terms at each time step for the nodal suspended sediment concentrations. The model yields stable and converging solutions. Partial verification was carried out against a series of erosion-deposition experiments in the laboratory using kaolinite and a natural mud as sediment. Model applications under prototype conditions are described. (Authors' abstract)
W87-05980

RESPONSE OF AQUATIC VEGETATION TO SEDIMENTATION DOWNSTREAM FROM RIVER CHANNELISATION WORKS IN ENGLAND AND WALES,
Freshwater Biological Association, Wareham (England). River Lab.
For primary bibliographic entry see Field 5G.
W87-06002

DRAG OVER CYLINDRICAL OBSTACLES IMMERSED IN THE FLOW OF A CONCENTRATED SUSPENSION OF SOLID PARTICLES IN WATER (TRAINEE SUR DES OBSTACLES CYLINDRIQUES IMMERGES DANS L'ECOULEMENT D'UNE SUSPENSION CONCENTREE DE PARTICULES SOLIDES EN EAU),
Institut de Mecanique de Grenoble, Saint-Martin d'Heres (France).
For primary bibliographic entry see Field 8B.
W87-06006

ORGANIC COPPER AND CHROMIUM COMPLEXES IN THE INTERSTITIAL WATERS OF NARRAGANSETT BAY SEDIMENTS,
Rhode Island Univ., Narragansett. Graduate School of Oceanography.
For primary bibliographic entry see Field 5A.
W87-06056

INFLUENCE OF INFREQUENT FLOODS ON THE TRACE METAL COMPOSITION OF ESTUARINE SEDIMENTS,
Maryland Univ., College Park. Dept. of Chemistry.
G. R. Helz, and S. A. Sinex.
Marine Chemistry MRCHBD, Vol. 20, No. 1, p 1-11, October 1986. 3 fig, 2 tab, 24 ref.

Descriptors: *Sediments, *Sediment sorting, *Sedimentary basins, *Sedimentation, *Trace metals, *Heavy metals, *Estuaries, *Estuarine sediments, *Floods, Basins, Manganese, Nickel, Copper, Zinc, Chesapeake Bay, Coastal plains, Susquehanna River, Rivers, River basins.

By use of iron variation diagrams, it was shown that the concentrations of Mn, Ni, Cu, and Zn in sediments of upper Chesapeake Bay are 50-75% lower than expected if they were simple mixtures of their apparent source materials: eroding Atlantic Coastal Plain deposits and material delivered by the Susquehanna River under ordinary discharge conditions. The Fe concentrations in the sediments, on the other hand, are consistent with derivation from these sources. Evidence is presented that the other ratios of total Mn, Cu, and Zn to Fe in the Susquehanna River decline during high discharge events. Because such events are responsible for removal of a major fraction of the total material carried out of the river basin, it is likely that the upper bay sediments simply reflect the long-term average composition of material from the basin. Averaging over a period much greater than one year is necessary to obtain a meaningful estimate of the trace element composition of materials being removed from this river basin. (Author's abstract)
W87-06058

TRACE METAL SEASONAL VARIATIONS IN TEXAS MARINE SEDIMENTS,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 5B.
W87-06059

COMPARISON OF TWO METHODS FOR DETERMINING COPPER PARTITIONING IN OXIDIZED SEDIMENTS,
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 5A.
W87-06061

13C NMR SPECTRA AND CU(II) FORMATION CONSTANTS FOR HUMIC ACIDS FROM FLUVIAL, ESTUARINE AND MARINE SEDIMENTS,
Florida Inst. of Tech., Melbourne.
For primary bibliographic entry see Field 2K.
W87-06062

DIURNAL VARIATIONS IN THE CHEMICAL ENVIRONMENT OF A SHALLOW TIDAL INLET, GULF ST VINCENT, SOUTH AUSTRALIA: IMPLICATIONS FOR WATER QUALITY AND TRACE METAL MIGRATION,
Adelaide Univ. (Australia). Dept. of Geology.
For primary bibliographic entry see Field 5B.
W87-06065

ACCUMULATION OF CR(III) BY BACTERIA ISOLATED FROM POLLUTED SEDIMENT,
Otago Univ., Dunedin (New Zealand). Dept. of Microbiology.
For primary bibliographic entry see Field 5B.
W87-06067

MECHANISMS CONTROLLING THE SEDIMENTATION SEQUENCE OF VARIOUS ELEMENTS IN PREALPINE LAKES,
Konstanz Univ. (Germany, F.R.). Limnological Inst.
H. H. Stabel.
IN: Chemical Processes in Lakes, John Wiley and Sons, New York, New York. 1985. p 143-167, 15 fig, 3 tab, 49 ref.

Descriptors: *Sedimentation, *Path of pollutants, *Limnology, *Prealpine lakes, *Lake sediments, *Lake Constance, Phytoplankton, Organic matter, Calcite, Chemical precipitation, Organic carbon, Phosphorus, Nitrogen, Silicon, Sedimentation rates, Algae.

Sedimentation rates in several prealpine lakes revealed considerable differences both in quantity and annual patterns as shown by sediment-trap technology. The phytoplankton seems to play a major role in the formation of particles in these lakes, while allochthonous minerals were of minor importance. In Lake Constance the annual succession of different algal species supposedly controls the seasonal patterns of the settling fluxes of organic matter, phosphorus, nitrogen, and silicon. Three major types of settling material were evaluated: (1) particulate organic matter; (2) autochtonously precipitated calcite; and (3) allochtonous minerals. The annual flux of particulate organic matter increased from oligotrophic to eutrophic lakes. Turnover of particulate organic carbon in the euphotic zone was shown to be enhanced in more productive lakes. In Lake Constance, flagellates, blue-greens, and dinoflagellates were shown to be nearly completely remineralized in the euphotic zone, while diatoms and their remains transferred the bulk of particulate organic matter, silicon, and phosphorus to the lake bottom. Pronounced maxima of sedimentation rates of calcium were not correlated with maxima of supersaturation, but presumably were triggered by several algal species. Settling fluxes of silicon deriving from lacustrine sources were closely related to biomass development of diatoms throughout the year. (See also W87-06126) (Author's abstract)
W87-06133

PHOSPHATE INTERACTIONS AT THE SEDIMENT-WATER INTERFACE,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
For primary bibliographic entry see Field 2H.
W87-06135

INFLUENCE OF COAGULATION AND SEDIMENTATION ON THE FATE OF PARTICLES, ASSOCIATED POLLUTANTS, AND NUTRIENTS IN LAKES,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W87-06136

ESTUARINE PROCESSES AND RIVERBORNE POLLUTANTS,
Kiel Univ. (Germany, F.R.). Inst. fuer Meereskunde.
For primary bibliographic entry see Field 2L.
W87-06192

EFFICIENT CONTROL OF AGRICULTURAL SEDIMENT DEPOSITION IN WATER COURSES,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Economics.
J. B. Braden, G. V. Johnson, and D. G. Martin.
IN: Options for Reaching Water Quality Goals, Proceedings of the Twentieth Annual Conference of the American Water Resources Association Symposium, Washington, DC., August 15, 1984. 1985. p 69-76, 2 fig, 1 tab, 18 ref. Illinois Water Resources Center project No. 1-1-11381 and Illinois Agricultural Experiment Station project No. 1-6-53491.

Descriptors: *Sedimentation, *Deposition, *Agriculture, *Water quality control, Model studies, Simulation analysis, Economic aspects, Nonpoint pollution sources, Soil erosion.

The usefulness of the Sediment Economics (SEDEC) simulation model for the design of an economically efficient strategy for reducing sediment deposition in stream segments was demonstrated. SEDEC conjoins farm planning economics, including a function relating soil losses to crop yields, and a sediment delivery relationship. The model can be used to identify minimum payments needed to make a landowner indifferent between unconstrained farming and the best land management practices to attain specified reductions in sediment loads. When used for a watershed, the model can delineate a least-cost set of practices for limiting sediment deposition from all farm units. Thus, the model redresses a key institutional weakness in controlling agricultural pollution: the lack of analytical tools for directing sediment control measures toward least cost changes in land management practices on farms. (See also W87-06270) (Author's abstract)
W87-06276

TRANSPORT OF TRACER GRAVELS ON A COASTAL CALIFORNIA RIVER,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
G. M. Kondolf, and W. V. G. Matthews.
Journal of Hydrology JHYDA7, Vol. 85, No. 3/4, p 265-280, July 1986. 7 fig, 3 tab, 19 ref.

Descriptors: *Tracers, *Bed load, *Gravel, *Environmental tracers, *Carmel River, *Sediment transport, California, Flow, Capillarity, Friction Loss, Percolation, Vortices, Morphology, Sediments.

Tracer gravels may provide information about the transport of coarse gravels not sampled by standard sampling methods. White dolomite fragments emplaced as riprap on the Carmel River in California were entrained by progressively higher flows in 1981-1983 and were carried progressively further. Following the 1981 flow, tracer gravel concentration decreased exponentially downstream.

After the 1982 and 1983 flows, the distribution of gravels reflected channel morphology, not an exponential downstream decrease. Peak concentrations corresponded to locations of major gravel bars. While tracer concentration decreased overall in the downstream direction, its distribution suggested not continuous movement but discrete 'jumps' from bar to bar. Calculation of bedload transport rates for rocks > 45 mm by spatial integration of tracer data yields bedload transport rates of about 3-5% of the total bedload flux measured by Helley-Smith sampler 5.5 km downstream. The results show the dominant influence of channel morphology on tracer gravel distribution, reflecting the importance of in-channel storage sites in coarse sediment movement. (Author's abstract)
W87-06299

MOVEMENT OF KEPONE(R) (CHLORDECONE) ACROSS AN UNDISTURBED SEDIMENT-WATER INTERFACE IN LABORATORY SYSTEMS,
Environmental Research Lab., Gulf Breeze, FL.
For primary bibliographic entry see Field 5B.
W87-06333

MAYFLY-MEDIATED SORPTION OF TOXICANTS INTO SEDIMENTS,
Fish and Wildlife Service, Washington, DC. Div. of Resource Contaminant Assessment.
For primary bibliographic entry see Field 5B.
W87-06334

SEDIMENT QUALITY CRITERIA FROM THE SEDIMENT QUALITY TRIAD: AN EXAMPLE,
E.V.S. Consultants Ltd., North Vancouver (British Columbia).
For primary bibliographic entry see Field 5A.
W87-06351

STUDY OF SOIL EROSION ON VERTISOLS OF THE EASTERN DARLING DOWNS, QUEENSLAND. II: THE EFFECT OF SOIL, RAINFALL, AND FLOW CONDITIONS ON SUSPENDED SEDIMENT LOSSES,
Queensland Dept. of Primary Industries, Toowoomba (Australia). Wheat Research Inst.
D. M. Freebairn, and G. H. Wockner.
Australian Journal of Soil Research ASORAB, Vol. 24, No. 2, p 159-172, 1986. 8 fig, 1 tab, 23 ref.

Descriptors: *Runoff, *Suspended sediments, *Sediments, *Soil erosion, *Suspended load, *Rainfall intensity, *Tillage, *Contour banks, Erosion control, Australia, Weirs, Discharge measurement.

Runoff water was sampled as it discharged through weirs installed at the outlet of 1 ha contour bay catchments. Cover, rainfall intensity, and soil tilth were important factors determining the concentration of suspended sediment in runoff. Mean delivery ratios for a grey clay, and a black earth, were 0.19 and 0.13, respectively. Contour banks reduced sediment loads reaching the bottom of slope by at least six-fold. Three methods of calculation of total sediment loss were assessed. A flow-weighted mean of rising stage samples, and the arithmetic mean of sequential samples, were adequate in most cases for determining sediment losses. Sequential samples weighted for discharge between samples were necessary for reliable measurements, however, especially during complex events. (Author's abstract)
W87-06386

EFFECTS OF SEDIMENT-LADEN FLOW ON CHANNEL BED CLOGGING,
Montana State Univ., Bozeman. Dept. of Civil Engineering and Engineering Mechanics.
A. B. Cunningham, C. J. Anderson, and H. Bouwer.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 113, No. 1, p 106-118, February 1987. 5 fig, 13 ref.

Descriptors: *Hydrodynamics, *Sedimentation, *Channel flow, *Channels, *Open channels, *Clogging, *Bed load, *Sediment load, Sediment transport, Suspended load, Suspended solids, Sediments, Soil properties, Flow, Flow velocity, Infiltration rate.

In open channel systems the phenomenon commonly referred to as clogging is caused by settling and straining of suspended sediment as water moves through the channel bed material, as well as by microbial transport, colonization, and other biological and chemical action. A three-year investigation of the clogging process due to accumulation of fine soil particles as it occurs in sediment-laden open channel flow is summarized. Significant results include experimental relationships developed between major independent variables (i.e., flow velocity, suspended sediment concentration, and suspended sediment particle size distribution) and the infiltration reduction occurring through a sand bed filter in the bottom of a recirculating laboratory flume. Factors affecting both the magnitude and temporal variation of channel bed infiltration are explained as well as observed differences in the physical nature of the clogged layer developed atop the filter bed. Significant features of sedimentary clogging in open channel flow are also correlated with traditional hydraulic and sediment transport variables and processes. In addition, a dimensional analysis of sedimentary clogging is presented as a focus for future experimental investigation. (Author's abstract)
W87-06417

GREAT RIVER RESOURCE MANAGEMENT STUDY: EROSION AND SEDIMENT INVENTORY.
Soil Conservation Service, Columbia, MO.
Available from the National Technical Information Service, Springfield, VA. as AD-A122 630. Army Engineer District, St. Louis, M.O., Final Report, June 1982. 177 p, 34 fig, 49 tab, 45 ref. USDA Contract No. DACW43-81-C-0071.

Descriptors: *Sediment data, *Erosion, *Sedimentation, *Mississippi River, Soil loss, Sediment load, Statistical analysis, Data collections, Data interpretation, Suspended sediment, Aggregates.

Erosion and sediment data for the Mississippi River and for 12 adjacent Water Resource Hydrologic Units from Sayerton, Missouri, to Cairo, Illinois, were gathered and analyzed. An estimated 67 million tons of annual soil loss from the 12 Water Resource Hydrologic Units accounts for 6% of the average annual sediment load passing Thebes, Illinois. At present, an estimated 115 million tons of sediment on the average annually passes by St. Louis, Missouri. The weighted average sediment load of the Missouri River at Hermann, Missouri, between 1929 and 1952 was 243 million tons. This sediment load at Hermann has continued to decrease to 70.7 million tons in 1980. However, the sediment load at St. Louis has remained fairly constant since 1960. Beginning in 1966 an inverse relationship of discharge to suspended sediment concentration is documented for the Missouri River at Hermann. Since 1960, total discharge at St. Louis appears to be increasing. In statistical analyses of suspended sediment concentrations at Hermann, Missouri, and Hannibal, Missouri, only 50% of the annual variation in sediment concentration could be explained by discharge. Untreated and treated analyses for grain size determinations of suspended sediment taken from the Missouri and Mississippi Rivers were significantly different. Specific surface area of sediment samples ranged from 87 to 203 sq m/gm. Surface area determinations using ethylene glycol monoethyl ether (EGME) were not significantly different for treated samples vs. native water samples. Aggregate size distribution measured from native water samples is not useful in computing surface area. Of four chemicals added during water treatment at the St. Louis, Missouri, and Alton, Illinois, water treatment plants to facilitate filtering and settling of impurities, only ferric sulfate correlated with suspended solids. (Author's abstract)
W87-06432

SAN LORENZO RIVER SEDIMENTATION STUDY: NUMERICAL MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
R. R. Copeland.
Available from the National Technical Information Service, Springfield, VA. 22161. Army Corps of Engineers, Waterways Experiment STation, Vicksburg, MS. Technical Report HL-86-10, December 1986. Final Report. 75 p, 25 fig, 6 tab, 17 plates, 24 ref, append.

Descriptors: *San Lorenzo River, *Sedimentation, *Model studies, *Flooding, *California, Mathematical models, Degradation, Aggradation, Channel morphology, Scour, Bank erosion, Flood control, Computer programs, Computer models.

A one-dimensional numerical model (HEC-6) was used to determine the effects of sediment deposition and erosion for a 2-mile reach of the San Lorenzo River in Santa Cruz, California. The numerical model was calibrated to simulate measured degradation and aggradation that occurred during a major flood event in 1982. With the existing channel geometry, scour preceding the 50-year or greater flood will be insufficient to allow the flood peak to pass through the project without hitting low chords at existing bridges. The 50-year flood profile exceeded the average low-chord elevation at Riverside Avenue and Laurel Street. The 100-year and SPF profiles also exceeded the average low-chord elevation at Soquel Avenue. Calculated water-surface elevations for the 100-year flood and the SPF were greater than top-of-levee elevations at some locations. Even if the channel is dredged to its design invert, the SPF will not match the design water-surface profile due to bed scour and aggradation preceding the peak, and will hit low chords at Riverside Avenue and Laurel Street. The flood could still be contained within channel freeboard depending on the backwater effect of the two bridge decks. With the channel annually being maintained at design invert grade, the average annual dredging would be about 62,000 cu yd. Deposition quantities will vary significantly depending on the annual hydrograph and the sediment inflow concentration. If the existing channel were allowed to continue to aggrade, and a series of annual flow-duration floods occurred, the average annual deposition would reach a 'stead-state rate of approximately 1,200 cu yd in about 10 years. During these first 10 years, the deposition rate would be higher and a total of about 65,000 cu yd would be deposited. These rates would vary significantly depending on the annual hydrograph and sediment inflow concentration. It can be concluded that any proposed design would require some dredging for channel maintenance. (Lantz-PTT)
W87-06528

ECOPHYSIOLOGICAL ADAPTATIONS OF ANAEROBIC BACTERIA TO LOW PH: ANALYSIS OF ANAEROBIC DIGESTION IN ACIDIC BOG SEDIMENTS,
Wisconsin Univ.-Madison. Dept. of Bacteriology.
For primary bibliographic entry see Field 5A.
W87-06544

NAPHTHALENE BIODEGRADATION IN ENVIRONMENTAL MICROCOSMS: ESTIMATES OF DEGRADATION RATES AND CHARACTERIZATION OF METABOLITES,
National Center for Toxicological Research, Jefferson, AR.
For primary bibliographic entry see Field 5B.
W87-06545

PORTABLE DEVICE FOR MEASURING SEDIMENT RESUSPENSION,
California Univ., Santa Barbara. Dept. of Mechanical and Environmental Engineering.
For primary bibliographic entry see Field 7B.
W87-06583

GEOLOGICAL DEVELOPMENT OF LARGE LAKES OF THE HUMID ZONE IN THE EUROPEAN PART OF THE SOVIET UNION,

AND HOLOCENE CLIMATIC CHANGES OF THE BASIS OF LAKE SEDIMENT DATA,
Akademiya Nauk SSSR, Leningrad. Inst. Ozerovedeniya.
For primary bibliographic entry see Field 2H.
W87-06589

GEOLOGY OF THE HOLOCENE IN THE WESTERN PART OF THE NETHERLANDS,
Rijks Geologische Dienst, Haarlem (Netherlands).
For primary bibliographic entry see Field 2L.
W87-06623

OCCURRENCE AND SIGNIFICANCE OF PEAT IN THE HOLOCENE DEPOSITS OF THE GERMAN NORTH SEA COAST,
Niedersaechsisches Landesamt fuer Bodenforschung, Hanover (Germany, F.R.)
For primary bibliographic entry see Field 2L.
W87-06624

SOILS AND THEIR GEOGRAPHY,
Stichting voor Bodemkartering, Wageningen (Netherlands).
For primary bibliographic entry see Field 2G.
W87-06627

2K. Chemical Processes

CALCITE DEPOSITION FROM CARBONACEOUS PARTICLES SCAVENGED BY SNOW,
Bologna Univ. (Italy). Ist. di Geologia.
For primary bibliographic entry see Field 5B.
W87-05975

DETERMINATION OF TIN IN THE NG/G RANGE BY DIFFERENTIAL PULSE POLAROGRAPHY,
Institut fuer Spektrochemie und Angewandte Spektroskopie, Dortmund (Germany, F.R.).
For primary bibliographic entry see Field 5A.
W87-05981

ELECTRON PARAMAGNETIC RESONANCE SPECTROSCOPY IN STUDIES OF THE CHEMICAL STATES OF MANGANESE IN PARTICULATE SUBSTANCES IN RIVER WATERS AND OF THE REDUCTION OF MANGANESE BY TANNERY EFFLUENTS,
Hyogo Prefecture Environmental Science Inst., Kobe (Japan).
For primary bibliographic entry see Field 5A.
W87-05982

FLOW-INJECTION CONFIGURATIONS FOR CHROMIUM SPECIATION WITH A SINGLE SPECTROPHOTOMETRIC DETECTOR,
Cordoba Univ. (Spain). Dept. of Analytical Chemistry.
J. Ruz, A. Rios, M. D. Luque de Castro, and M. Valcarcel.
Analytica Chimica Acta ACACAM, Vol. 186, p 139-146, August 1986. 3 fig, 2 tab, 14 ref. CAICyT Grant 2012-83.

Descriptors: *Chromium, *Flow injection analysis, *Spectrophotometry.

Flow injection analysis has not been widely used to distinguish different chemical forms of the same element. The simultaneous or sequential determination of chromium (VI) and total chromium in water by flow injection analysis, using different configurations with a double- or single-beam spectrophotometer as detector, is investigated. The method is based on reaction between chromium (VI) and 1,5-diphenylcarbazide. Chromium (III) and (VI) are distinguished by using two carrier streams, one of which contains cerium (IV) to oxidize chromium (III) to chromium (VI). The determination range is 0.2-10.0 micrograms Cr/ml; the r.s.d. is 0.8% for 1 microgram Cr. The sampling frequency is 40/h. A wide study of interferences is reported. (Authors' abstract)
W87-05983

DETERMINATION OF BISMUTH IN RIVER SEDIMENT BY ELECTROTHERMAL ATOMIC ABSORPTION SPECTROMETRY WITH LOW TEMPERATURE ATOMIZATION IN ARGON/HYDROGEN,
For primary bibliographic entry see Field 5A.
W87-05984

SIMULTANEOUS DETERMINATION OF TOTAL NITROGEN AND TOTAL PHOSPHORUS IN FRESHWATER SAMPLES USING PERSULFATE DIGESTION,
National Inst. for Environmental Studies, Tsukuba (Japan).
M. Hosomi, and R. Sudo.
International Journal of Environmental Studies IJEVAW, Vol. 27, No. 3/4, p 267-275, 1986. 2 fig, 6 tab, 17 ref.

Descriptors: *Water analysis, *Nitrogen, *Phosphorus, Chemical analysis, Detection limits, Performance evaluation, Chemical processes.

The accuracy and precision of total nitrogen (T-N) and total phosphorus (T-P) determinations in freshwater samples by the simultaneous digestion method using an oxidizing reagent solution of NaOH-K2S2O8 were assessed. Detection limits based on the blank test of nitrogen and phosphorus were 0.02 mg N/l and 0.001 mg P/l, respectively. This simultaneous digestion method gave not only a high recovery and reproducibility over a wide range of various nitrogen and/or phosphorus compounds of known nitrogen and phosphorus compositions, but also high recoveries of nitrogen and phosphorus from standard reference materials, such as orchard leaves, pond sediment, and chlorella. No significant difference was found between the determinations of T-N and T-P in freshwater samples by this method and those determined by the standard methods of T-N and T-P, respectively. This method should be useful for the routine analysis of T-N and T-P in freshwater samples containing particulate material and samples of low T-N and/or T-P concentration. (Authors' abstract)
W87-05990

TOXICITY OF COPPER COMPLEXES TO THE MARINE DIATOM NITZSCHIA CLOSTERIUM,
Commonwealth Scientific and Industrial Research Organization, Sutherland (Australia). Div. of Energy Chemistry.
For primary bibliographic entry see Field 5C.
W87-06037

RELATIONSHIP BETWEEN CHRONIC TOXICITY AND BIOACCUMULATION OF COPPER, CADMIUM AND ZINC AS AFFECTED BY WATER HARDNESS AND HUMIC ACID,
Miami Univ., Oxford, OH. Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W87-06043

ACUTE LETHAL TOXICITY OF HYDROCARBONS AND CHLORINATED HYDROCARBONS TO TWO PLANKTONIC CRUSTACEANS: THE KEY ROLE OF ORGANISM-WATER PARTITIONING,
Toronto Univ. (Ontario). Inst. for Environmental Studies.
For primary bibliographic entry see Field 5C.
W87-06044

INTERACTIVE EFFECTS OF WATER HARDNESS AND HUMIC ACID ON THE CHRONIC TOXICITY OF CADMIUM TO DAPHNIA PULEX,
Miami Univ., Oxford, OH. Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W87-06048

INCREASED AVAILABILITY OF CADMIUM TO PERFUSED RAINBOW TROUT (SALMO GAIRDNERI, RICH.) GILLS IN THE PRESENCE OF THE COMPLEXING AGENTS DIETHYL DITHIOCARBAMATE, ETHYL XANTHATE AND ISOPROPYL XANTHATE,
Uppsala Univ. (Sweden). Dept. of Zoophysiology.
For primary bibliographic entry see Field 5C.
W87-06049

IMPROVED GAS CHROMATOGRAPHIC METHOD FOR THE MEASUREMENT OF HYDROXYLAMINE IN MARINE AND FRESH WATERS,
Oregon State Univ., Corvallis. School of Oceanography.
For primary bibliographic entry see Field 7B.
W87-06057

TRACE METAL TRANSPORT IN TWO TRIBUTARIES OF THE UPPER CHESAPEAKE BAY: THE SUSQUEHANNA AND BUSH RIVERS,
Florida Univ., Gainesville. Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5B.
W87-06060

13C NMR SPECTRA AND CU(II) FORMATION CONSTANTS FOR HUMIC ACIDS FROM FLUVIAL, ESTUARINE AND MARINE SEDIMENTS,
Florida Inst. of Tech., Melbourne.
M. Sohn, and D. Weese.
Marine Chemistry MRCHBD, Vol. 20, No. 1, p 61-72, October 1986. 6 fig, 2 tab, 24 ref.

Descriptors: *Spectral analysis, *Sediments, *Fluvial sediments, *Marine sediments, *Estuarine sediments, *Estuaries, *Nuclear magnetic resonance, *Humic acids, Carbon, Copper, Formation constants, Acids, Heavy metals, Florida, Organic carbon, Aromatic compounds, Aliphatic hydrocarbons, Comparison studies.

Humic acids extracted from fluvial, estuarine and marine sediments from the eastern coast of Florida were studied by CP/MAS 13C nuclear magnetic resonance. The freshwater humic acid contained a large percentage of lignin-derived aromatic carbon whereas the offshore marine samples contained large amounts of aliphatic carbon. The aliphatic carbon of the marine humic acids was more highly branched than that found for freshwater and estuarine sediments. Despite significant differences in the relative amounts and types of carbon present, conditional formation constants for Cu(II)-humic acid were very similar. (Author's abstract)
W87-06062

ARSENIC, ANTIMONY AND SELENIUM SPECIATION DURING A SPRING PHYTOPLANKTON BLOOM IN A CLOSED EXPERIMENTAL ECOSYSTEM,
Southampton Univ. (England). Dept. of Chemistry.
S. C. Apte, A. G. Howard, R. J. Morris, and M. J. McCartney.
Marine Chemistry MRCHBD, Vol. 20, No. 2, p 119-130, November 1986. 6 fig, 2 tab, 22 ref.

Descriptors: *Speciation, *Phytoplankton, *Eutrophication, *Ecosystems, *Arsenic, *Antimony, *Selenium, Aquatic plants, Plankton, Diatoms, Scotland, Phosphates, Silicates, Depletion, Ions, Biochemistry, Heavy metals.

The effects of a spring diatom bloom on the levels and speciation of dissolved arsenic, antimony and selenium in the water enclosed in an experimental ecosystem moored in Loch Ewe (NW Scotland) were studied. Primary productivity resulted in severe depletion of phosphate and silicate in the bag, but had little effect on the levels and speciation of arsenic and antimony. Calculations based on phosphate depletion data strongly suggest that the field diatom population present during the experiment was capable of some degree of discrimination between the phosphate and arsenate ions. While biomethylation of arsenic was not observed in the upper region of the bag, where the phytoplankton population was at its greatest, the methylated form accounted for 64% of the dissolved

arsenic at the base of the bag. In this region, however, the total dissolved arsenic levels were not higher than in the rest of the bag, suggesting microbial methylation rather than the release of methylated arsenic from decaying phytoplankton. Total dissolved selenium and selenium(IV) showed some evidence of depletion during the development of the phytoplankton bloom, in support of previous observations of preferential selenite assimilation. (Author's abstract)
W87-06063

INFLUENCE OF VEGETATIVE SUCCESSION ON SOIL CHEMISTRY OF THE BERKSHIRES,
Williams Coll., Williamstown, MA.
For primary bibliographic entry see Field 5C.
W87-06076

CONCEPTUAL MODELS FOR TRANSPORT AT A REDOX BOUNDARY,
Freshwater Biological Association, Ambleside (England).
W. Davison.
IN: Chemical Processes in Lakes, John Wiley and Sons, New York, New York. 1985. p 31-53, 9 fig, 59 ref.

Descriptors: *Model studies, *Limnology, *Oxidation-reduction potential, *Path of pollutants, Oxidation, Chemical reactions, Vertical distribution, Lake sediments, Metals.

Fundamental features which are common to the transport of all elements in the vicinity of a redox boundary are discussed. For simplicity, detailed examples are restricted to iron and manganese. Conceptual understanding is based on oxidation or reduction reactions generating a point source, from which newly formed material is transported by random processes. The shapes of concentration - depth profiles of both soluble and particulate components in marine and freshwater sediments and water columns are reviewed. The diverse shapes encountered in nature are due to the particular modifying factors which affect each situation; these factors are discussed in detail. Generally, transport either entirely within a water column or within a sediment, may be simply treated because the rate of vertical transport can be regarded as constant. The situation at the sediment-water interface is complicated by the discontinuity in the rate of transport. When the redox boundary coincides with this interface or resides in the sediment, soluble components are transported from the sediment to the water column. However, when the redox boundary occurs in the water column under steady-state conditions, soluble species diffuse from the overlying water to the sediment. The soluble reduced forms of the metals play the major role in transport processes within sediment where particles are relatively immobile. Transport away from particulate peaks within the sediments is therefore usually controlled by chemical processes. In water columns, where advective mixing acts equally on particles and solutions, both components are actively transported and particles are additionally subject to gravitational sinking. The problems associated with using instantaneous measurements of concentration gradients to estimate fluxes are highlighted, and the use of complementary methods is recommended. (See also W87-06126) (Author's abstract)
W87-06128

AQUEOUS SURFACE CHEMISTRY: ASSESSMENT OF ADSORPTION CHARACTERISTICS OF ORGANIC SOLUTES BY ELECTROCHEMICAL METHODS,
Institut Rudjer Boskovic, Zagreb (Yugoslavia). Center for Marine Research.
For primary bibliographic entry see Field 7B.
W87-06129

CARBON ISOTOPES AND PRODUCTIVITY IN THE LACUSTRINE AND MARINE ENVIRONMENT,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Geologisches Inst.
For primary bibliographic entry see Field 2H.
W87-06131

REDOX-RELATED GEOCHEMISTRY IN LAKES: ALKALI METALS, ALKALINE-EARTH ELEMENTS, AND 137-CS,
Woods Hole Oceanographic Institution, MA.
For primary bibliographic entry see Field 2H.
W87-06132

PAVIN CRATER LAKE,
Ecole Normale Superieure, Paris (France). Lab. de Geologie.
For primary bibliographic entry see Field 2H.
W87-06134

PHOSPHATE INTERACTIONS AT THE SEDIMENT-WATER INTERFACE,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
For primary bibliographic entry see Field 2H.
W87-06135

COUPLING OF ELEMENTAL CYCLES BY ORGANISMS: EVIDENCE FROM WHOLE-LAKE CHEMICAL PERTURBATIONS,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 2H.
W87-06137

GEOBIOLOGICAL CYCLE OF TRACE ELEMENTS IN AQUATIC SYSTEMS: REDFIELD REVISITED,
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab. for Water Resources and Hydrodynamics.
For primary bibliographic entry see Field 5B.
W87-06138

KINETICS OF CHEMICAL PROCESSES OF IMPORTANCE IN LACUSTRINE ENVIRONMENTS,
California Inst. of Tech., Pasadena. Dept. of Environmental Engineering Science.
J. J. Morgan, and A. T. Stone.
IN: Chemical Processes in Lakes, John Wiley and Sons, New York, New York. 1985. p 389-426, 8 fig, 1 tab, 51 ref.

Descriptors: *Chemical processes, *Lakes, *Kinetics, *Chemical reactions, Model studies, Hypolimnion, Chemical properties, Kinetics, Equilibrium.

The characteristic reaction times of chemical processes, AB to A + B, treated by first-order rate laws range from nanoseconds (e.g., MnSO4 aq. to MN(2+) + SO4(2-)) to teraseconds (e.g., racemization of aminoacids). For chemical processes described by second-order rate laws, A + B to AB, and reactant concentrations at the millimolar level, characteristic reaction times are known to range from about 10 ns to far in excess of decades, under chemical conditions encountered in freshwater environments. Such a wide range in characteristic reaction times suggests that kinetic models of lake water chemical processes are required under conditions where the characteristic time of reaction, tau sub ch, is comparable to the residence time tau sub R, of the epilimnetic or hypolimnetic environment of a lake. For tau sub ch < tau sub R, an equilibrium model of the chemical process can yield useful information on the speciation in the lake water. For very slow processes, with tau sub ch > tau sub R, these reactions can be neglected. In general, there are chemical reactions of interest in hypolimnetic and epilimnetic waters (e.g., oxidation-reduction, hydrolysis, precipitation or dissolution) that are characterized by a wide range of reaction times. These reaction times often depend strongly on the chemical speciation of the lake water. Simultaneous application of kinetic and equilibrium descriptions for those processes with tau sub ch approximately equal to tau sub R and those for which tau sub ch < tau sub R, respectively, yields 'constrained equilbrium' or 'pseudoequilibrium' models. This can result in considerable simplification for the prediction of physical-chemical speciation in natural waters. The required information comprises the initial concentration conditions for all components of interest, the rate laws or slow chemical processes (or corresponding transport expressions or diffusionally-limited processes), and thermodynamic data for species involved in fast reactions. (See also W87-06126) (Author's abstract)
W87-06143

PROCEEDINGS OF THE BANGKOK SYMPOSIUM ON ACID SULPHATE SOILS.
International Inst. for Land Reclamation and Improvement, Wageningen (Netherlands).
For primary bibliographic entry see Field 2G.
W87-06162

DIRECTIONS OF FURTHER RESEARCH ON ACID SULFATE SOILS,
International Rice Research Inst., Los Banos, Laguna (Philippines).
For primary bibliographic entry see Field 2G.
W87-06163

FACTORS INFLUENCING THE FORMATION OF POTENTIAL ACIDITY IN TIDAL SWAMPS,
Agricultural Univ., Wageningen (Netherlands). Dept. of Soil Science and Geology.
For primary bibliographic entry see Field 2L.
W87-06165

MICROBIOLOGICAL PROCESSES AFFECTING CHEMICAL TRANSFORMATIONS IN GROUNDWATER,
Stanford Univ., CA. Dept. of Civil Engineering.
P. L. McCarty, B. E. Rittmann, and E. J. Bouwer.
IN: Groundwater Pollution Microbiology, John Wiley and Sons, New York, New York, 1984. p 89-115, 9 fig, 6 tab, 55 ref. EPA Grant No. EPA-R-804431, and Grant No. EPA-R-808034010. NSF Grant No. CME-7905707.

Descriptors: *Chemical processes, *Groundwater pollution, *Path of pollutants, *Fate of pollutants, *Water pollution effects, Oxidation, Organic compounds, Bacteria, Groundwater movement, Biotransformation.

One aspect of the many changes brought about by microbial activity in groundwater is the kinetics of oxidation of inorganic and organic compounds when used for energy. Such oxidations represent the major route for biotransformation of organic contaminants in groundwater. Chemical oxidation of organic material is generally too slow for significant transformations to occur, and photolysis is virtually absent in groundwaters because of the absence of sunlight. The nature of the groundwater environment dictates that the predominant type of microbiological activity will be bacteria attached to solid surfaces in the form of biofilms. This results from the usually low substrate concentration and the high specific surface area, both of which strongly favor the predominance of biofilm bacteria. The attached bacteria remain generally fixed in one place and obtain energy and nutrients from the groundwater that flows by. A third microbiologically important characteristic of the groundwater environment is that heterotrophic bacteria are usually required to utilize numerous different organic compounds to obtain sufficient energy to sustain themselves. Furthermore, a significant portion of the organic matter, especially in groundwater containing recharged wastewaters, leachates, or spilled chemicals, consists of anthropogenic compounds which are resistant to bacterial degradation. (See also W87-06201) (Lantz-PTT)
W87-06206

HYDROGEOLOGY OF THE CENTRAL MACKENZIE VALLEY,
Carleton Univ., Ottawa (Ontario). Ottawa-Carleton Centre for Geoscience Studies
For primary bibliographic entry see Field 2F.

W87-06307

CHLOROFORM SORPTION TO NEW JERSEY COASTAL PLAIN GROUND WATER AQUIFER SOLIDS,
New Jersey Agricultural Experiment Station, New Brunswick.
For primary bibliographic entry see Field 5B.
W87-06310

PARTITIONING OF HEAVY METALS TO SUSPENDED SOLID OF THE FLINT RIVER, MICHIGAN,
Clarkson Coll. of Technology, Potsdam, NY. Dept. of Civil and Environmental Engineering.
L. M. McIlroy, J. V. DePinto, T. C. Young, and S. C. Martin.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 7, p 609-623, July 1986. 10 fig, 2 tab, 22 ref.

Descriptors: *Partition coefficients, *Chemical processes, *Path of pollutants, *Copper, *Zinc, *Adsorption, *Sediments, *Flint River, Michigan, Heavy metals, Isotherms, Mathematical equations.

The sorptive affinity of copper and zinc to suspended river sediments was investigated as a function of pH and adsorbent solids concentration. Water samples from the Flint River in Michigan were centrifuged to yield a composite sediment concentrate used as an adsorbent in experiments determining pH adsorption edges and conditional adsorption isotherms. Copper and zinc exhibited sharp pH adsorption edges at pH values of approximately 4 to 5.5 and 6 to 7, respectively. Both metals exhibited fractional adsorption decreases as total metal in the system increased. Adsorbent concentration increases were shown to cause decreases in measured copper partition coefficients. The indirect relationship between adsorbent concentration and partition coefficient was observed whether the adsorbent was concentrated or diluted without altering bulk solution chemistry. A mathematical formulation that incorporated both the adsorbent mass effects and the separation of sorbed metal into reversible and resistant components satisfactorily described the observations. (Author's abstract)
W87-06331

SORPTION OF LOW-POLARITY ORGANIC COMPOUNDS ON OXIDE MINERALS AND AQUIFER MATERIAL,
Air Force Engineering and Services Center, Tyndall AFB, FL. Engineering and Services Lab.
T. B. Stauffer, and W. G. MacIntyre.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 11, p 949-955, November 1986. 2 fig, 6 tab, 12 ref.

Descriptors: *Path of pollutants, *Organic compounds, *Sorption, *Aquifers, *Chemical reactions, *Isotopes studies, Transport, Groundwater, Isotherms, Minerals, Acidity.

Sorption plays a significant role in the transport of low-polarity organic compounds by ground water. Most contaminant movement is through saturated aquifers of low organic carbon content. Sorption processes on these materials may be different from those on high-organic surface soils. Batch sorption isotherms using 14C-labeled compounds were determined on mineral oxides and aquifer materials; the sorbents used were Al2O3, Al(OH)3, FeO(OH) (goethite) and aquifer material. A surface soil sorbate was used for comparison with the sorption of the low-carbon materials; the sorbates used were 1-methylnaphthalene, naphthalene, trichloroethylene and o-dichlorobenzene. The acidity and ionic strength were varied to simulate different ground water conditions. The order of sorption coefficients for all sorbents was 1-methylnaphthalene > naphthalene > o-dichlorobnzene > trichloroethylene. In general, sorption of each compound was strongest for the surface soil and decreased in the order of surface soil > >FeO(OH) > aquifer material > aluminum oxides. Under basic conditions, the sorption coefficients were significantly reduced in all cases. Sorption increased slightly at high ionic strengths. (Author's abstract)
W87-06350

QUANTITATIVE INDEX OF THE ION BALANCE FOR PRECIPITATION CHEMISTRY,
Institute of Public Health, Tokyo (Japan). Dept. of Public Health Practice.
For primary bibliographic entry see Field 2B.
W87-06373

SURFACE CHARGE CHARACTERISTICS AND LIME REQUIREMENTS OF SOILS DERIVED FROM BASALTIC, GRANITIC, AND METAMORPHIC ROCKS IN HIGH-RAINFALL TROPICAL QUEENSLAND,
Commonwealth Scientific and Industrial Research Organization, Townsville (Australia). Div. of Soils.
For primary bibliographic entry see Field 2G.
W87-06387

COMPARISON OF SOME PHYSICOCHEMICAL PARAMETERS OF HUMIC SUBSTANCES ISOLATED FROM THREE DIFFERENT AQUATIC ECOSYSTEMS,
Polish Academy of Sciences, Poznan. Dept. of Agrobiology and Forestry.
For primary bibliographic entry see Field 5A.
W87-06561

2L. Estuaries

MUD ACCUMULATION IN ESTUARINE CHANNELS - A QUESTION OF DREDGING,
Institut fuer Meeresforschung, Bremerhaven (Germany, F.R.).
For primary bibliographic entry see Field 2J.
W87-05949

HOLOCENE GEOLOGIC HISTORY OF A TRANSFORM MARGIN ESTUARY: ELKHORN SLOUGH, CENTRAL CALIFORNIA,
Moss Landing Marine Labs., CA.
D. L. Schwartz, H. T. Mullins, and D. F. Belknap.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 22, No. 3, p 285-302, March 1986. 14 fig, 30 ref.

Descriptors: *Estuaries, *Geologic history, *Paleohydrology, *Paleoecology, Sea level, Tectonics, Monterey Bay, California, Salt marshes.

Elkhorn Slough is the second largest estuary in California and the first estuarine sanctuary in the United States. It occupies the western reaches of Elkhorn Valley, a relic river valley eroded by drainage from the Santa Clara and/or Great Valley of California into Monterey Bay during the early Pleistocene. During the mid-late Pleistocene Elkhorn Valley was tectonically truncated from its headwaters by right-lateral movement along the San Andreas Fault. During the last glacial maximum, 16,000 to 18,000 years before present (B.P.), local drainage in Elkhorn Valley incised a stream channel at least 29 m below present day sea-level, as its base level was progressively lowered. With the ensuing Holocene sea-level rise, marine waters invaded this incised channel, floored with nonmarine sandy gravels, creating a high energy tidal inlet at the mouth of Elkhorn Slough approximately 8000 years B.P. As sea-level continued to rise, the main channel of Elkhorn Slough became filled by an estuarine, fining-upward sequence characterized by progressively shallower, lower-energy deposits. A quiet water sanctuary, considerably larger than the present-day Elkhorn Slough, existed approximately 3000 years B.P. As the Slough was slowly filling, salt marshes developed along its landward margins and have progressively advanced toward the center of the Slough during the past 5000 years. In the mid-1850s Elkhorn Slough was a minor tributary to the much larger Pajaro-Salinas River system which shared a common entrance to the Pacific Ocean north of Moss Landing. In 1909 winter storms modified the course of the Salinas River to its present location south of Moss Landing, while Elkhorn Slough persisted as a tributary to the old Salinas River channel. Construction of jetties at the Moss Landing Harbor in 1946 provided a direct link between the Pacific Ocean and Elkhorn Slough. At this time, salt marshes began to retreat from the axis of Elkhorn Slough as it evolved into its present form as a relatively stable estuarine embayment. Had the jetties not been installed, Elkhorn Slough would have likely evolved into a freshwater wetland and eventually into a dry alluvial valley within 2000 years. The future fate of Elkhorn Slough will undoubtedly be controlled by relative sea-level changes, sediment supply, and human activities. (Authors' abstract)
W87-05970

POPULATION DYNAMICS OF THE ONUPHID POLYCHAETE DIOPATRA CUPREA (BOSC) ALONG A TIDAL EXPOSURE GRADIENT,
Duke Univ., Durham, NC. Dept. of Botany.
P. Peckol, and D. Baxter.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 22, No. 3, p 371-377, March 1986. 1 fig, 2 tab, 26 ref.

Descriptors: *Polychaetes, *Estuaries, *Population dynamics, *Tidal effects, Sediments, Beaufort, North Carolina.

Differences in density or demographic characteristics are often a reflection of a response of an organism to habitat heterogeneity. Processes governing the abundance and distribution of organisms may be better understood by studying within-population variations, that is, viewing the responses of patches (subpopulations) to seasonal and spatial variations. By means of a technique for mapping permanent quadrats, recruitment and survival were followed for an intertidal, sand flat population of Diopatra cuprea in the North River Estuary, Beaufort, North Carolina. Relatively constant, distinctive densities were maintained, for more than a year, for three populations monitored in low (longest tidal exposure), medium and high (shortest tidal exposure) density areas. Mortality in the low density area was relatively high from late spring through early fall, coincident with increasing water and air temperatures. Peak mortality in the medium and high density areas occurred in winter. Although recruitment into all three sites was low, the high density area had a greater number of recruits than the other two sites. Highest adult survival offset lowest recruitment to maintain the medium density subpopulation. Thus this area had the lowest population turnover (6.1 years) of the three sites. The high density site had the greatest rate of population turnover (2.9 years), reflecting highest states of mortality and recruitment. The use of long-term, individual monitoring is an effective method of studying variation in population dynamics. (Authors' abstract)
W87-05971

AERIAL SURVEY OF A SALT MARSH: ICE RAFTING TO THE LOWER INTERTIDAL ZONE,
New Hampshire Univ., Durham. Jackson Estuarine Lab.
M. N. Hardwick-Witman.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 22, No. 3, p 379-383, March 1986. 1 fig, 3 tab, 7 ref.

Descriptors: *Salt marshes, *Peat, *Ice drift, Intertidal areas, *Aerial photography, *Estuaries, Great Bay Estuary, New Hampshire.

Ice can have a significant impact on the architecture of salt marshes in temperate regions. In Great Bay Estuary, New Hampshire, ice cover is present from late December to early March. The average maximum thickness of ice is 35 cm, and ranges up to 60 cm. The thickest sections are found in anchor ice, formed when the ice freeze locks onto the surface of the salt marsh and is not lifted by the rising tide. In the spring, the ice cover is weakened by increasing temperature, wind and waves, often removing portions of salt marsh peat when it breaks up during ice-out. The process of ice rafting chunks of peat (peat islands) to the tidal flats is an erosional, as well as depositional, mechanism. The

purpose of this study was to (1) quantify the abundance of peat islands in order to address the importance of ice transport, and (2) to evaluate the hypothesis that salt marsh peat was rafted from the high to the low intertidal zone. An aerial photographic survey was conducted using an ultralight aircraft to assess both the extent and the directionality of ice rafted salt marsh peat in a northern New England salt marsh. To address the extent of ice rafting, a map was constructed from aerial photographs to determine the number, area and percentage of the tidal flat covered by accumulated ice rafted peat islands. Seven percent of the tidal flat or 117.4 sq m of the salt marsh embayment was covered by 202 transported peat islands. To address the direction of ice rafting, an ice tagging experiment tested the hypothesis that salt marsh peat is transported from the high to the low intertidal. Eighty-eight percent of the recovered ice rafted peat islands were transported to lower intertidal elevations. Thus the ice rafting process is an important physical disturbance in this north temperate salt marsh and has the potential to impact the salt marsh peat community. (Author's abstract)
W87-05972

RECONSTRUCTION AND ANALYSIS OF METEOROLOGICAL DATA FOR ENERGY BALANCES OVER THE VENETIAN LAGOON AND ITS HINTERLAND,
Venice Univ. (Italy). Dept. of Environmental Science.
I. Lauagnini, D. Camuffo, and A. Bernardi.
The Science of the Total Environment STENDL, Vol. 50, p 139-146, April 1986. 6 fig, 13 ref. Commission of the European Communities Contract ENV 757 I-SB.

Descriptors: *Meteorological data collection, *Energy, *Solar radiation, *Mathematical models, *Model studies, Atmosphere, Climatology, Lagoons, Air pollution.

Global solar radiation must be taken into consideration when determining an energy balance. This parameter was needed to make a mathematical model of the Venetian Lagoon and its hinterland. Solar radiation depends on both astronomical and meteorological factors and can be expressed in terms of transparency of the atmosphere and attenuation coefficients. The purpose of this paper is to evaluate these atmospheric variables for Venice and compute the net radiation over the water and soil surfaces. To this end, the seasonal variation of the global solar radiation over a 10-year period was analysed. The normalized daily transparency coefficients and the atmospheric attenuation coefficients, as well as the net radiative fluxes over both the lagoon and the land, were computed and are discussed in terms of the local dynamic climatology. The results are particularly interesting because of their practical applications, which include air pollution studies, emission strategy, thermal pollution of shallow waters, local climatology, and the preservation of works of art. (Authors' abstract)
W87-05974

MODELLING COHESIVE SEDIMENT TRANSPORT IN ESTUARIAL WATERS,
For primary bibliographic entry see Field 2J.
W87-05980

INFLUENCE OF INFREQUENT FLOODS ON THE TRACE METAL COMPOSITION OF ESTUARINE SEDIMENTS,
Maryland Univ., College Park. Dept. of Chemistry.
For primary bibliographic entry see Field 2J.
W87-06058

TRACE METAL SEASONAL VARIATIONS IN TEXAS MARINE SEDIMENTS,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 5B.
W87-06059

13C NMR SPECTRA AND CU(II) FORMATION CONSTANTS FOR HUMIC ACIDS FROM FLUVIAL, ESTUARINE AND MARINE SEDIMENTS,
Florida Inst. of Tech., Melbourne.
For primary bibliographic entry see Field 2K.
W87-06062

ARSENIC, ANTIMONY AND SELENIUM SPECIATION DURING A SPRING PHYTOPLANKTON BLOOM IN A CLOSED EXPERIMENTAL ECOSYSTEM,
Southampton Univ. (England). Dept. of Chemistry.
For primary bibliographic entry see Field 2K.
W87-06063

PETROLEUM HYDROCARBONS IN THE MEDITERRANEAN SEA: A MASS BALANCE,
Bermuda Biological Station for Research, St. George's West.
For primary bibliographic entry see Field 5B.
W87-06064

DIURNAL VARIATIONS IN THE CHEMICAL ENVIRONMENT OF A SHALLOW TIDAL INLET, GULF ST VINCENT, SOUTH AUSTRALIA: IMPLICATIONS FOR WATER QUALITY AND TRACE METAL MIGRATION,
Adelaide Univ. (Australia). Dept. of Geology.
For primary bibliographic entry see Field 5B.
W87-06065

STRUCTURAL FLOOD MITIGATION WORKS AND ESTUARINE MANAGEMENT IN NEW SOUTH WALES - CASE STUDY OF THE MACLEAY RIVER,
New South Wales Dept. of Agriculture, Sydney (Australia). Div. of Fisheries.
For primary bibliographic entry see Field 6G.
W87-06074

USE OF SEVIN ON ESTUARINE OYSTER BEDS IN TILLAMOOK BAY, OREGON,
For primary bibliographic entry see Field 5G.
W87-06075

COASTAL ZONE PROBLEMS - A FEDERAL PERSPECTIVE,
Corps of Engineers, Dallas, TX. Southwestern Div.
For primary bibliographic entry see Field 6E.
W87-06152

WATER RESOURCES AND THE COASTAL ZONE,
North Carolina State Univ. at Raleigh. Sea Grant Coll. Program.
B. J. Copeland.
IN: Water Resources in Texas: The Need for a Water Research Agenda. Water Resources Symposium Number Eleven. University of Texas at Austin. Center for Research in Water Resources, 1984. p 167-180, 5 fig, 1 tab, 14 ref.

Descriptors: *Coastal zone management, *Coastal waters, *Water resources development, Management planning, Nurseries, Fisheries, Estuaries, Productivity, Public policy.

Coastal systems are valuable resources and depend upon an effective water resources management program for maintenance. Multi-disciplinary research is needed to characterize the functional and descriptive parameters essential for estuarine productivity. It is naive to assume that sound coastal zone management can proceed until the fundamental processes underlying coastal productivity are understood. The future of estuarine productivity is dependent upon the activities of universities, government, and the public, participating together and focusing on relevant issues, such as: estuaries as nurseries and fisheries, impact of water inflow on estuarine productivity, seasonal requirements, and the relationship of water resources to the coastal zone. Agency managers need to develop a better understanding of overall processes in order to ask more relevant questions. And last, but most important, the stewards of coastal resources, the people, should insist that their public agencies address the relevant issues. (See also W87-06144) (Lantz-PTT)
W87-06155

FACTORS INFLUENCING THE FORMATION OF POTENTIAL ACIDITY IN TIDAL SWAMPS,
Agricultural Univ., Wageningen (Netherlands). Dept. of Soil Science and Geology.
L. J. Pons, and N. Breeman.
IN: Proceedings of the Bangkok Symposium on Acid Sulphate Soils, Second International Symposium on Acid Sulphate Soils, Bangkok, Thailand, January 18-24, 1981. ILRI Publication 31, 1982. p 37-51, 3 fig, 2 tab, 24 ref.

Descriptors: *Soil reclamation, *Water pollution sources, *Tidal marshes, *Swamps, *Acidity, *Sedimentation, Acidic soils, Brackish water, Kaolinite, Sediments, Tidal effects.

An explanation is offered for the geographic distribution of potentially acid sulfate soil materials in relation to climatic zones and the physiography of coastal plains. For this purpose, potential acidity is defined as anexcess of pyrite over acid neturalizing components. The essential ingredients and environmental conditions for the formation, accumulation or sedimentation of pyrite and acid neutralizing components are listed and interpreted in terms of actual and past physiographic settings, illustrated by well-known situations. Potential acidity is built up predominantly in kaolinite-rich, non-calcareous sediments in tidal flats below mean high water level, with a dense mangrove vegetation, amply flushed by saline or brackish tides at a sedimentation rate allowing for the mangroves to persist well below mean high water level for at least several decades. These conditions are favored by a subsidence of the land relative to the sea level or by low sedimentation rates and by a tropical humid climate. A relative rise of the land or an increase in sedimentatino rate lead to rapid siltation of tidal creeks and quick lateral accretion of closed shorelines at levels well above mean sea level minimizes the influence of tidal flushing and mangrove vegetation, and thereby will depress the rate of pyrite accumulation and of decarbonization and consequently of the potential acidity in tidal deposits. (See also W87-06162) (Lantz-PTT)
W87-06165

ACID SULPHATE SOILS OF THE MANGROVE AREA OF SENEGAL AND GAMBIA,
Office de la Recherche Scientifique et Technique Outre-Mer, Paris (France).
C. Marius.
IN: Proceedings of the Bangkok Symposium on Acid Sulphate Soils, Second International Symposium on Acid Sulphate Soils, Bangkok, Thailand, January 18-24, 1981. ILRI Publication 31, 1982. p 103-136, 10 fig, 8 tab, 47 ref.

Descriptors: *Soil reclamation, *Mangrove swamps, *Senegal, *Gambia, *Acidic soils, *Sulfates, Intertidal areas, Clay, Sand, Estuaries, Land reclamation, Polders.

The mangrove area of Senegal and Gambia consists of intratidal flats with riverain mangrove forest and 'tannes', e.i. saline marshes partly with bare surfaces. Their soils are acid sulphate soils, very shallowly developed in peaty sulfidic mud clays and sands and subject to tidal flooding. The mangrove area covers a total of 500,000 ha and is concentrated in the estuaries of the Casamance, Gambia, and the Saloum. At present, mangrove forests are absent in the delta of the Senegal River. Tides are saline throughout the year in the Casamance and Saloum estuaries. In the Gambia and Senegal, the river flow pushes back the saline tides during the short rainy season from June/July to September/October. Traditional small-scale reclamation involved shallow drainage and controlled flooding with saline water to prevent drying of the subsoils during dry seasons. Rice was grown on raised beds constructed with top soil only. The beds were desalinized seasonally with the first rains. Salinity used to be a more serious hazard

than acidity in traditional rice fields. Modern, large-scale polders were designed to enable total exclusion of saline tides and desalinization of soils by deep drainage and leaching with fresh water stored in upstream reservoirs. This reclamation practice invoked an acidification of the soil that, with the available facilities for water management, could not be kept under control. The diminishing fresh wtar supply since 1972 increased both salinity and acidity problems in traditional and modern rice polders. In part of the empoldered areas productivity might be restored by combining controlled saline flooding and cultivation on raised beds with a new system of fresh water management aimed at shallow desalinization and flooding. (See also W87-06162) (Lantz-PTT)
W87-06169

ESTUARINE PROCESSES AND RIVERBORNE POLLUTANTS,
Kiel Univ. (Germany, F.R.). Inst. fuer Meereskunde.
J. C. Duinker.
IN: Pollutants and Their Ecotoxicological Significance, John Wiley and Sons, Chichester, England, 1985. p 227-238, 4 fig, 2 tab, 30 ref.

Descriptors: *Estuaries, *Path of pollutants, *Rivers, *Heavy metals, *Rhine River, *Sediment transport, Cadmium, Zinc, Copper, Manganese, Iron, River sediments, Suspended sediments.

Rivers transport trace metals to the ocean in dissolved, colloidal and particulate forms. In estuaries, where river water and coastal or oceanic waters of widely different compositions are mixed, strong gradients in chemical and physicochemical properties occur. As a result, the relative contributions of the chemical species of any element to these forms can be modified considerably. A significant fraction of river borne Cd, Zn, Cu, Mn, and Fe is deposited in bottom sediments of the Rhine estuary. This is the result of the trapping mechanism of the estuary for suspended particles as well as the removal of dissolved components into particulate components during estuarine mixing. Attempts are made to distinguish the effects of physical and physicochemical mechanisms that contribute to the observations during surveys and hourly observations at fixed stations in different salinity regimes of the estuary. (See also W87-06187) (Lantz-PTT)
W87-06192

TRANSPORT, FATE AND RECYCLING OF HEAVY METALS IN SEA-WATER ECOSYSTEMS,
Vrije Univ., Brussels (Belgium). Lab. of Ecology and Systematic Botany.
For primary bibliographic entry see Field 5B.
W87-06193

MODELS OF WATER QUALITY IN ESTUARIES,
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
D. J. Elliott, and A. James.
IN: An Introduction to Water Quality Modelling, John Wiley and Sons, Chichester, England. 1984. p 109-128, 10 fig, 3 ref.

Descriptors: *Estuaries, *Model studies, Water quality management, Hydraulic properties, Water quality control, Tides, Tidal hydraulics, Mixing, Biological oxygen demand, Dissolved oxygen, Mathematical models.

Conditions in estuaries are more complex than in rivers and are therefore more difficult to model. Hydraulically there are three complications: (a) Two directional flow resulting from the interaction between freshwater flow and tidal movements; (b) Density differences between the freshwater (also effluents) entering an estuary and the saline water entering from the sea. This results in a variable degree of mixing. Also the density differences tend to create a gravitational circulation pattern; (c) Rivers tend to widen out as they enter estuaries and the resulting water body is often subject to a horizontal circulation pattern due to the Coriolis effect. Biologically, estuaries are a distinct part of the river system. The transition zone between freshwater and marine conditions is unfavorable for the vast majority of aquatic plants, animals and microorganisms. From a modeling viewpoint it is important to identify the populations at risk so that appropriate environmental parameters can be used. The standards generally adopted for estuaries are as follows: (i) No nuisance standard-dissolved oxygen < 1 mg/L and no surface slick of oil and a limit on suspended solids, and (ii) Coarse fish standard-dissolved oxygen <3 mg/L and a limit on toxins. The common feature of all these standards is the concentration of dissolved oxygen. Estuary models, like river modes therefore tend to be concerned with BOD/DO relationships. There is an important difference however in the method of expressing the oxygen demand of the organic matter. Retention times in estuaries are much greater than in the freshwater reaches of rivers and allow time for complete oxidation to occur. The concept of BOD (5-day retention) is therefore replaced by UOD (20-day retention). (See also W87-06216) (Lantz-PTT)
W87-06222

CHESAPEAKE CHALLENGE: RESTORATION AND PROTECTION,
Environmental Protection Agency, Annapolis, MD. Chesapeake Bay Liaison Office.
For primary bibliographic entry see Field 5G.
W87-06273

LABORATORY STUDIES ON THE REMOBILISATION OF ACTINIDES FROM RAVENGLASS ESTUARY SEDIMENT,
UKAEA Atomic Energy Research Establishment, Harwell (England). Environmental and Medical Sciences Div.
For primary bibliographic entry see Field 5B.
W87-06392

DEPOSITION AND PERSISTENCE OF AERIALLY-APPLIED FENTHION IN A FLORIDA ESTUARY,
Harbor Branch Oceanographic Institution, Inc., Ft. Pierce, FL.
For primary bibliographic entry see Field 5B.
W87-06422

ORGANOCHLORINE LEVELS IN EDIBLE MARINE ORGANISMS FROM KUWAITI COASTAL WATERS,
International Lab. of Marine Radioactivity, Monaco-Ville (Monaco).
For primary bibliographic entry see Field 5B.
W87-06424

MERCURY IN FLOUNDER, PLATICHTYS FLESUS, COD, GADUS MORHUA, AND PERCH, PERCA FLUVIATILIS, IN RELATION TO THEIR LENGTH AND ENVIRONMENT,
Fish Technology Inst. TNO, Ijmuiden (Netherlands).
For primary bibliographic entry see Field 5B.
W87-06426

WETLANDS AND WATER QUALITY: A REGIONAL REVIEW OF RECENT RESEARCH IN THE UNITED STATES ON THE ROLE OF FRESHWATER AND SALTWATER WETLANDS AS SOURCES, SINKS, AND TRANSFORMERS OF NITROGEN, PHOSPHORUS, AND VARIOUS HEAVY METALS,
Rhode Island Univ., Kingston. Graduate School of Oceanography.
S. W. Nixon, and V. Lee.
Available from the National Technical Information Service, Springfield, VA. 22161. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS. Technical Report Y-86-2, October 1986. Final Report. 229 p, 20 fig, 95 tab, 452 ref.

Descriptors: *Wetlands, *Water quality, *Limnology, *Estuaries, Saline water, Sinks, Nitrogen, Phosphorus, Heavy metals, Literature review, Nutrients.

This report is the first in a series of four literature reviews on wetland functions and values. Each review covers one of the following four broad wetlands functions and values: (1) water quality, (2) fish and wildlife habitat, (3) socioeconomics, and (4) hydraulics. The four reports, along with other information, were used to develop a multiyear wetlands functions and values research study plan implemented by the US Army Engineer Waterways Experiment Station. This report examines the literature on water quality functions of wetlands. Study results indicated considerable diversity in the quantity and quality of wetlands water quality literature between and within each geographic region of the coterminous United States and Alaska. In general, wetlands water quality has been studied most intensely in the estuarine marshes of the Gulf and North Atlantic coasts. Water quality in freshwater wetlands has not received attention commmensurate with the wide distribution of these wetland types. Most previous wetlands water quality research has been fragmented into site-specific or function-specific studies. Very few mass balance studies have been conducted. Two complementary approaches to addressing wetlands water quality research data gaps are recommended. The first approach is to develop mass balances or budgets of carbon, nutrients, heavy metals, and other possible pollutants. The mass balance studies should be determined at carefully selected field sites over several annual cycles. The second approach would focus on the design, construction, and use of experimental wetland microcosms. The microcosms would permit assessment of the fates and effects of various materials under highly controlled conditions. (Lantz-PTT)
W87-06529

EXAMINATION OF THE FATE OF NIGERIAN CRUDE OIL IN SURFACE SEDIMENTS OF THE HUMBER ESTUARY BY GAS CHROMATOGRAPHY AND GAS CHROMATOGRAPHY-MASS SPECTROMETRY,
Newcastle upon Tyne Univ. (England). Organic Geochemistry Unit.
For primary bibliographic entry see Field 5B.
W87-06590

PROCEEDINGS OF THE SYMPOSIUM ON PEAT LANDS BELOW SEA LEVEL.
International Inst. for Land Reclamation and Improvement, Wageningen (Netherlands).
For primary bibliographic entry see Field 2H.
W87-06622

GEOLOGY OF THE HOLOCENE IN THE WESTERN PART OF THE NETHERLANDS,
Rijks Geologische Dienst, Haarlem (Netherlands).
S. Bijlsma.
IN: Proceedings of the Symposium on Peat Lands Below Sea Level, August 24-28, 1981, The Netherlands. IRLI Publication No. 30, 1982. p 11-30, 7 fig, 3 tab, 26 ref.

Descriptors: *Geologic history, *The Netherlands, *Glaciation, *Peat soils, *Peat bogs, Geology, Coastal marshes, Geomorphology, Dunes, Geologic time, Geologic formations, Lithologic logs, Geologic mapping, Glacial sediments, Sea level, Soil types, Geological surveys, Stratigraphy, Peat.

After the last glaciation, rapid melting of the ice sheets resulted in a fast rise in sea level during the Holocene. The sea invaded a gently sloping plain dipping to the west. As a result of the rapidly rising sea level a thick sequence of clastic sediments and some peat was formed behind small coastal barriers. This peat was mainly formed in the landward part of the area enclosed by the coastal barriers. After 5000 BP, the rate of the relative rise in sea level was much less. The coastal barriers became better developed, and behind them peat formed over the marine deposits. The formation of peat was locally interrupted by incursions of seawater through the coastal barriers, and dunes developed on top of these barriers. After 2000 BP, part of the coastal-barrier system was broken up by the sea. Some of the peat was eroded and marine deposits were formed in this area. Large dunes

were formed on the remains of the coastal barriers. (See also W87-06622) (Author's abstract)
W87-06623

OCCURRENCE AND SIGNIFICANCE OF PEAT IN THE HOLOCENE DEPOSITS OF THE GERMAN NORTH SEA COAST,
Niedersaechsisches Landesamt fuer Bodenforschung, Hanover (Germany, F.R.)
H. Streif.
IN: Proceedings of the Symposium on Peat Lands Below Sea Level, August 24-28, 1981, The Netherlands. IRLI Publication No. 30, 1982. p 31-41, 25 ref.

Descriptors: *Peat, *Peat bogs, *Coastal marshes, *Geomorphology, Tidal flats, Peat soils, Bights, Geology, Geologic history, Sea level, Coasts, Marine sediments, Barrier islands, Sedimentation, Soil horizons, Soil types, Dikes.

The present configuration of the German Bight on the North Sea coast is part of a changing geologic process. Coastal peat deposits show lateral zonation, while close to the Pleistocene hinterland, pure sedentary sequences of peat are developed. Between these two regions is a transitional zone in which peat layers occur intercalated in clastic sediments. The barrier islands are built up of sandy sediments and contain sand dunes up to 20 m high. The present tidal flat area and the marshlands are built up of sandy and silty tidal-flat sediments and clayey lagoonal deposits of a subaqueous environment including the intertidal zone. Many of the basal peats were formed in typical inland mires under various conditions. The intercalated peat layers are mostly Phragmites peat and sedge peat, but wood peat and raised bog peat also occur. A transitional sequence from a fen peat to a raised bog peat is a very important criterion with regard to water-level oscillations. The occurrence of raised bog peat on the top of Phragmites peat or sedge peat indicates that the natural plant succession of the filling-up process has been interrupted by the sinking of the groundwater-level. Horizons of decomposed peat, often found within sequences of relatively fresh fen peat, can be regarded as a type of soil formation and indicate at least a temporary lowering of the groundwater table. Local facies, incomplete sedimentary sequence due to erosion, and the varying influence of compaction make it difficult to correlate peat layers or sedimentary layers over long distances in the coastal Holocene. Reaction of man to variations in sea-level along the German North Sea coast is seen in the building of clay dwelling mounds prior to the 10th century and the systematic building of dikes thereafter. Breaching of dikes caused great land losses between the 12th and 16th centuries. (See also W87-06622) (Geiger-PTT)
W87-06624

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

COMPARISON OF REVERSE OSMOSIS AND ELECTRODIALYSIS FOR REMOVAL OF NITRATE FROM GROUNDWATER (PROZESSVERGLEICH VON UMKEHROSMOSE UND ELEKTRODIALYSE AM BEISPIEL DER NITRAT-ENTFERNUNG AUS GRUNDWAESSERN),
Technische Hochschule Aachen (Germany, F.R.). Inst. fuer Verfahrenstechnik.
R. Rautenbach, W. Kopp, G. van Opbergen, T. Peters, and R. Hellekes.
Chemieingenieurtechnik CITEAH, Vol. 58, No. 12, p 938-945, December 1986. 20 fig, 7 tab, 8 ref.

Descriptors: *Reverse osmosis, *Desalination, *Electrodialysis, *Desalination, *Denitrification, Membrane processes, Nitrates, Chemical industry, Design criteria, Drinking water, Groundwater, Comparative studies, Costs.

Reverse osmosis and electrodialysis are membrane processes suitable for desalination of aqueous solutions. Both processes were tested on a pilot scale in a waterworks (Wasserwerk Gatzweiler in Moenchengladbach) for removal of nitrates from groundwater. A combination of the processes was also conducted with a view to very high concentration of the residual water. Information gathered from long-term reverse osmosis trials and the experiments at the electrodialysis plant with industrial membrane dimensions can provide a basis for safe design of large plants. Treatment costs for large capacities are shown for the example of the above mentioned feed water. The advantages and disadvantages of reverse osmosis and electrodialysis are compared. This comparison demonstrates fitting applications of the two processes in other areas (chemical industry, sewage treatment). (Author's abstract)
W87-06011

HETEROGENEOUS MECHANISM OF VAPORIZATION IN A FLOW OF STRONGLY SUPERHEATED WATER,
For primary bibliographic entry see Field 8B.
W87-06014

SOLAR DESALINATION IN CONJUNCTION WITH CONTROLLED ENVIRONMENTAL AGRICULTURE IN ARID ZONES,
Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Chemistry.
A. I. Kudish, and J. Gale.
Energy Conversion and Management ECMADL, Vol. 26, No. 2, p 201-207, 1986. 2 fig, 7 tab, 9 ref.

Descriptors: *Solar stills, *Desalination, *Agriculture, *Environmental control, *Arid zone, *Greenhouses, Zones, Conservation, Water conservation, Reverse osmosis, Brackish water, Economic aspects, Economic evaluation, Economic efficiency, Desalination apparatus, Cost analysis.

A modular, easy on-site construction, low-cost solar still was designed and tested for juxtaposition to a controlled environmental agriculture (CEA) greenhouse. The cost of solar still construction has been reduced, relative to that of typical basin-type solar stills, by as much as 20%. Annual average daily productivity and efficiency values were 2.35 l/sq m and 30%, respectively. The feasibility of using the greenhouse's hot brackish water reservoir as the still feedstock for enhanced nocturnal production was tested and found to enhance productivity significantly (about 40% on an annual basis). A total life cycle cost analysis of the still has shown it to be less economical by a factor of 1.25 relative to a small reverse osmosis unit for brackish water for the CEA farm size considered. However, the solar still has the advantage of requiring only an unskilled operation and maintenance staff and the solar still may be more economical in the case of sea water desalination. (Author's abstract)
W87-06020

3B. Water Yield Improvement

DIRECT INTERCEPTION OF CLOUD AND FOG WATER,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
P. C. Ekern.
IN: Collected Reprints, Volume V: 1978-1981, June 1984. Water Resources Research Center, Honolulu, Hawaii. p 93-101, 7 fig, 21 ref.

Descriptors: *Fog, *Clouds, *Orographic precipitation, *Interception, Water supply development, Water resources development, Water vapor, Artificial precipitation.

Direct interception of fog and cloud water can make a significant contribution to the water budget of an area. Quantitive studies of the potential amount of fog interception depend on the design of a standardized catcher. Louvered aluminum shade screen was used to intersect fog on windward and leeward slope transects in Hawaii. Results showed that direct interception of fog and cloud water contributed an amount equivalent to half the rainfall on the windward slopes in the fog belt; on the leeward slopes, the interception was one-fourth the rainfall. In general, a summertime maximum prevailed for interception. The areas with interception are extensive, but the boundaries are sharply defined. Above the inversion, interception falls off rapidly. Interception is negligible on slopes lacking the orographic or sea breeze cloud. Selected ridge sites can have interception of cloud and fog water several times the rainfall levels. (See also W87-06103) (Geiger-PTT)
W87-06110

TRADE-OFFS BETWEEN PRIVATE RAINWATER CISTERNS AND PUBLIC WATER SUPPLY SYSTEMS,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
Y. S. Fok.
IN: Collected Reprints, Volume V: 1978-1981, June 1984. Water Resources Research Center, Honolulu, Hawaii. p 216-221, 4 ref.

Descriptors: *Cisterns, *Water supply, *Urban areas, *Municipal water, *Cost-benefit analysis, Water tanks, Water supply development, Water conveyance, Rain, Rainfall, Economic aspects, Cost analysis, Storm water.

Rainwater cistern systems for residential water supply and other uses has been practiced in Hawaii and many other places for a long time. However, rainwater cisterns are more expensive to the consumer than public water systems. In the areas of stormwater management in urban areas, energy conservation, and environmental and social quality maintenances, rainwater cisterns fare better than public water supply systems. In locations where there is a shortage of public water supply capacity or in remote areas, rainwater cisterns may be the only feasible alternative for water supply. Besides residential uses, rainwater cistern systems have been used to provide water for livestock, lawn and landscape maintenance, swimming pools, cooling and fire protection. (See also W87-06103) (Geiger-PTT)
W87-06115

3C. Use Of Water Of Impaired Quality

GROWTH OF DUCKWEED AND NUTRIENT REMOVAL IN A PADDY FIELD IRRIGATED WITH SEWAGE EFFLUENT,
Ehime Univ., Matsuyama (Japan). Dept. of Environment Conservation.
For primary bibliographic entry see Field 5E.
W87-05991

COLLECTED REPRINTS, VOLUME V: 1978-1981.
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 4B.
W87-06103

GROUNDWATER RECHARGE ASPECTS FOR AN ISLAND ENVIRONMENT,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 4B.
W87-06108

RECLAIMED SEWAGE EFFLUENT FOR SUGARCANE PRODUCTION IN A SUBTROPICAL AREA,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
L. S. Lau, and G. L. Dugan.
IN: Collected Reprints, Volume V: 1978-1981, June 1984. Water Resources Research Center, Honolulu, Hawaii. p 144-153, 2 fig, 13 ref.

Descriptors: *Water reuse, *Wastewater irrigation, *Wastewater disposal, *Irrigation practices, *Sug-

arcane, Wastewater renovation, Water demand, Land application, Land disposal, Crop production, Leachates.

The island of Oahu, Hawaii (USA), where more than 80% of the state's population resides, is projected to have a water demand that will equal its fully developed freshwater supply by the year 2000. It appears that reuse and reclamation are the most feasible means of water supplementation for the insular environment. A recently completed seven-year field project on Oahu involving the application of a secondary sewage effluent to grassland and sugarcane revealed that it does not have a detrimental effect on the vegetation or on public health; it serves as a fertilizer source and as a sewage disposal method; the quality of the leachate below the root zone is similar to agriculture practices; at least 50% of the applied liquid reaches the groundwater when the ridge-and-furrow method or irrigation is used; and approximately 106,000 cu m/day (28 mgd) of adequate quality treated sewage within an economically feasible distance of sugarcane lands is presently available with 193,000 cu m/day (51 mgd) being projected for 1990. This quantity of sewage effluent should be sufficient to irrigate at least 1700 and 3090 ha (4200 and 7635 acres), respectively, of sugarcane. (See also W87-06103) (Author's abstract)
W87-06112

RECYCLING WASTEWATER EFFLUENT FOR SUGARCANE IRRIGATION: THE MILILANI PROJECT,
Hawaii Univ. at Manoa, Honolulu. Dept. of Civil Engineering.
R. H. F. Young.
IN: Collected Reprints, Volume V: 1978-1981, June 1984. Water Resources Research Center, Honolulu, Hawaii. p 234-242, 7 ref.

Descriptors: *Water reuse, *Wastewater irrigation, *Sugarcane, *Wastewater disposal, Wastewater renovation, Land application, Crop yield, Land disposal, Resources management, Irrigation water, Water supply, Irrigation programs, Recycling.

The Mililani Project, a long term research effort begun in 1971, investigated the feasibility of recycling wastewater effluent for sugarcane irrigation. The initial phase of the project consisted of the application of secondary effluent on the grounds of the Mililani Sewage Treatement Plant to determine the short-term and seasonal changes in the resultant leachate after passage through a Hawaiian agricultural soil. Results showed that the secondary effluent was suitable for irrigation. Results of field application of the effluent to sugarcane showed that, with proper water resource management, the cane yield was the same for effluent-treated and control fields. The second phase of the project evaluated the effects of applying differing ratios of effluent and ditch water for the crop cycle. Overall, the 25% dilution ratio, if total N in the effluent is controlled at <25% milligrams/liter, was found suitable for irrigation over the entire crop cycle. Efforts to use chlorinated effluent in drip irrigation systems met with little success due to plugging of drip tube orifices. (See also W87-06103) (Geiger-PTT)
W87-06117

WASTEWATER USE FOR IRRIGATION: A CASE HISTORY IN HAWAII,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
L. S. Lau.
IN: Collected Reprints, Volume V: 1978-1981, June 1984. Water Resources Research Center, Honolulu, Hawaii. p 302-312, 1 fig, 2 tab, 8 ref.

Descriptors: *Wastewater disposal, *Wastewater irrigation, *Land application, *Water reuse, Reclaimed water, Grasses, Bermudagrass, Land disposal, Surgarcane, Municipal wastewater, Wastewater renovation, Recycling, Water demand.

By the year 2000, it is projected that the island of Oahu, Hawaii where more than 80% of the state's population resides, will have a total water demand that will equal its high quality water supply. To investigate a major supplemental source and to help meet irrigation water demand, a 9 yr field project was carried out on Oahu to develop reclamation and reuse technology of municipal sewage effluent for application to sugarcane and grassland. Results of the study showed that the rotation and dilution methods for furrow application of effluent maintained sugar yield without polluting the groundwater. The high technology required for posttreatment of secondary effluent for drip irrigation was economically unfeasible. Effluent application to Bermudagrass and Californiagrass produced a high yield without polluting the groundwater. In 1980, two sugarcane plantations in water-short regions began using renovated wastewater for irrigation purposes. Usable effluent can supplement water sources on Oahu up to 65 mgd in the year 2020, permitting irrigation of at least 10,000 acres of sugarcane. (See also W87-06103) (Geiger-PTT)
W87-06121

NITROGEN ASPECTS OF IRRIGATED DOMESTIC WASTEWATER,
Hawaii Univ. at Manoa, Honolulu. Dept. of Civil Engineering.
G. L. Dugan, P. C. Ekern, and L. S. Lau.
IN: Collected Reprints, Volume V: 1978-1981, June 1984. Water Resources Research Center, Honolulu, Hawaii. p 313-319, 1 fig, 3 tab, 7 ref.

Descriptors: *Wastewater irrigation, *Wastewater disposal, *Nitrogen, *Bermudagrass, *Sugarcane, Nitrates, Nitrites, Water reclamation, Ammonia, Fertilizers, Water reuse, Wastewater renovation, Land reclamation, Denitrification, Leachates, Phosphorus, Nutrients, Municipal wastewater.

The use of secondary effluent for sugarcane and grassland irrigation in Hawaii was found to be a feasible method of crop irrigation, water conservation, and fertilization. In terms of groundwater protection, the oxidizable forms of N (nitrate and nitrite) are essentially the only constitutents that are frequently found in the leachate below the root zone in concentrations of concern. The organic N and ammonia N were decreased by soil sorption or micro- and macroorganisms. Lysimeter studies were conducted to investigate an apparant N deficiency in Bermudagrass. Denitrification by bacteria and the freeing of N gas to the atmosphere were assumed to be the causes of N loss. An estimation of N balance for field sugarcane culturing conditions showed that irrigation with undiluted effluent added N at rates far greater than the uptake capability of the cane and increased N in the percolate well above that from ditch-water irrigation once the effect of commercial fertilizer was dissipated. These findings emphasize the need for N monitoring of both the applied effluent and the leachate, and the need for effluent dilution if the N levels become too high. (See also W87-06103) (Geiger-PTT)
W87-06122

EFFLUENT IRRIGATION OF CALIFORNIAGRASS: N BUDGET AND CROP YIELDS,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
L. L. Handley.
IN: Collected Reprints, Volume V: 1978-1981, June 1984. Water Resources Research Center, Honolulu, Hawaii. p 320-327, 1 fig, 3 tab, 24 ref.

Descriptors: *Grasses, *Crop yield, *Wastewater irrigation, *Nitrogen, *Irrigation programs, Crop production, Wastewater disposal, Groundwater recharge, Fertilizers, Fodder, Leachates, Land disposal, Nutrients.

An effluent irrigation management method for Californiagrass was sought which would minimize percolate N, while allowing maximum rates of effluent irrigation. Large applications were needed on a small area for the method to be economical. Another objective was to produce a feed crop suitable for dairy cattle. Eight percolate-type lysimeters were installed and planted with slips of Californiagrass that were irrigated by drip pipes with chlorinated, secondary effluent. Water balance, applied N, percolate N, soil N, gaseous loss of N, harvested N and crop productivity and quality were evaluated during the experiment. Results showed that percolate N was < 10 milligrams/liter. Effluent irrigation provided good groundwater recharge and crop yield. The protein content of the grass was 13% and the caloric intake 4,000 kcal/kilogram, making it an excellent cattle fodder. For maximum application rates, 7.7% of applied N went to percolate, 13.3% to gaseous loss, and 79% to crop uptake. (See also W87-06103) (Geiger-PTT)
W87-06123

WASTEWATER IRRIGATION FOR BIOMASS PRODUCTION AND NITROGEN REMOVAL,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
L. L. Handley.
IN: Collected Reprints, Volume V: 1978-1981, June 1984. Water Resources Research Center, Honolulu, Hawaii. p 346-353, 1 fig, 2 tab, 12 ref.

Descriptors: *Grasses, *Fodder, *Nitrogen removal, *Wastewater irrigation, *Wastewater disposal, Crop yield, Fertilizers, Crop production, Nitrogen, Biomass, Lysimeters, Leachates, Water reuse, Wastewater renovation, Land disposal, Nitrates, Groundwater recharge.

The total N levels in Californiagrass grown in kaolinitic soil in eight lysimeters and irrigated with 0, 50 or 100% secondary wastewater effluent was measured. Results of water balance measurements showed that 99% of applied water went to percolate, making this an excellent groundwater recharge method. The Californiagrass displayed extremely efficient use of N, eliminating the need for secondary treatment and aerobic digestion of N in wastewater. Even at high rates of effluent application, percolate N levels were low. The method produced large quantities of a nutritionally balanced and palatable cattle fodder. For consistent N removal, the crop should be harvested every 6 weeks. (See also W87-06103) (Geiger-PTT)
W87-06125

PROBLEMS AND RESEARCH NEEDS WITH SAFE REUSE OF WATER,
Illinois Univ. at Urbana-Champaign. Inst. for Environmental Studies.
B. B. Ewing.
IN: Water Resources in Texas: The Need for a Water Research Agenda. Water Resources Symposium Number Eleven. University of Texas at Austin. Center for Research in Water Resources, 1984. p 139-165, 2 fig, 37 ref.

Descriptors: *Water reuse, *Wastewater renovation, Direct reuse, Indirect reuse, Wastewater effluents, Potable water, Water resources development, Water quality, Health effects.

In a sense, all waters are and always have been reused. That is the nature of the hydrologic cycle. The indirect reuse of water in a stream as upstream users return a portion of used water and others make use of it downstream has been practiced as long as people have settled along streams. Reuse, is the productive utilization of appropriately treated wastewater. Recycling is a special case of reuse wherein the wastewater originates with the user. Direct reuse is the piped connection of a wastewater effluent to the intake works of a water supply facility. Indirect reuse is the abstraction of water for productive use from a natural surface or underground source that is fed in part by discharge of wastewater effluent. Most reuse of water in the United States has been indirect reuse, but there have also been many examples of successful direct nonpotable reuse. Much can continue to be done without resorting to direct potable reuse. There is need for water resources planning that incorporates indirect and direct nonpotable reuse. Direct potable reuse is very near to being demonstrated as technologically feasible. Because of uncertainties about health effects and because there is still much public apprehension about it, direct potable reuse should be limited to carefully controlled experiments. Other alternatives for reuse should be developed first. Experimental potable reuse in South

Africa and soon in Denver, as well as indirect reuse for augmenting public water supply at Truckee, California, and Fairfax County, Virginia, will provide valuable research opportunities. Hopefully these experiments will be done in such a way as to demonstrate the feasibility of the concept and to provide an opportunity to demonstrate that the human health risks are acceptable so that public confidence can be fostered. (See also W87-06144) (Lantz-PT)
W87-06154

EVAPOTRANSPIRATION ESTIMATES DERIVED FROM SUBSOIL SALINITY DATA,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
For primary bibliographic entry see Field 2D.
W87-06296

DIFFERENTIAL MRNA TRANSCRIPTION DURING SALINITY STRESS IN BARLEY,
Science and Education Administration, Albany, CA. Western Regional Research Center.
S. Ramagopal.
Proceedings of the National Academy of Sciences of the United States of America, Vol. 84, No. 1, p 94-98, January 1987. 4 fig, 2 tab, 22 ref.

Descriptors: *Imperial water use, *RNA, *Plant tissues, *Transcription, *Salinity, *Salt tolerance, *Barley, *Plant physiology, Chemical properties, Salts, Environmental effects, Sodium chloride, Gels, Seedlings, Stress, Roots, Electrophoresis, Proteins.

The molecular and genetic bases of salinity tolerance in plants are not understood. Gene expression at the mRNA level was investigated in a salt-tolerant and a salt-sensitive genotype of barley. Seedlings were exposed to NaCl stress and translatable mRNAs were isolated from root and shoot tissues. A reticulocyte cell-free system was programed with barley mRNAs and the in vitro products were resolved on two-dimensional polyacrylamide gels following isoelectric focusing or nonequilibrium pH gradient gel electrophoresis in the first dimension. The functional mRNAs in unstressed seedlings were qualitatively almost indistinguishable in the two genotypes. However, salinity stress triggered differential transcription of specific mRNAs depending on genotype and tissue. In roots, 12 new mRNAs were induced that encoded proteins of 21-34 kDa, with pI range of 6.1-7.7. In shoots, the 9 new mRNAs coded for proteins of 18-50.5 kDa, with a pI range of 5.4-7.8. These new stress mRNAs represented one of two main classes. Class I consisted of mRNAs shared by both genotypes. Class II represented mRNAs specific to each genotype; unique mRNAs of roots accumulated preferentially in the salt-tolerant genotype, whereas those of shoots accumulated in the salt-sensitive genotype. The findings suggest that transcriptional as well as posttranscriptional mechanisms regulate gene expression on barley during salinity stress. (Author's abstract)
W87-06407

GENE INDUCTION AND REPRESSION BY SALT TREATMENT IN ROOTS OF THE SALINITY-SENSITIVE CHINESE SPRING WHEAT AND THE SALINITY-TOLERANT CHINESE SPRING X ELYTRIGIA ELONGATA AMPHIPLOID,
California Univ., Davis. Dept. of Agronomy and Range Science.
P. Gulick, and J. Dvorak.
Proceedings of the National Academy of Sciences of the United States of America, Vol. 84, No. 1, p 99-103, January 1987, 4 fig, 2 tab, 23 ref.

Descriptors: *Impaired water use, *RNA, *Acclimatization, *Wheat, *Plant tissues, *Salinity, *Salt tolerance, *Roots, *Chinese Spring wheat, *Plant physiology, *Chemical properties, Gene induction, Gene repression, Amphiploids, Leaves, Sodium chloride, Electrophoresis.

An artificial amphiploid from a cross between salinity-sensitive bread wheat cultivar Chinese Spring and highly tolerant Elytrigia elongata (Host) Nevski (= Agropyron elongatum Host) shows enhanced salinity tolerance relative to Chinese Spring. Poly(A)(+) RNA was isolated from the roots, expanding leaves, and old leaves from amphiploid and Chinese Spring plants prior to and after acclimation to high levels of NaCl in solution cultures. Two-dimensional gel electrophoresis of the in vitro translation products was used to compare these mRNA populations. The amphiploid had 10 mRNA species induced or enhanced and 8 species repressed in root tissue during acclimation to saline growth conditions. These 18 transcripts affected by salt treatment were also detected in wheat roots, but only 4 of these were similarly regulated. In Chinese Spring the acclimation to saline stress resulted in a marked change in the level of expression of 34 transcripts in root tissue; of these, 26 were detected in the amphiploid and only 6 were regulated as in the amphiploid. No differences were seen in gene expression between salt-treated and control plants in leaves and meristematic crowns and unexpanded leaves of the amphiploid. (Author's abstract)
W87-06408

GAS EXCHANGE AND GROWTH IN WHEAT AND BARLEY GROWN IN SALT,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.
For primary bibliographic entry see Field 2I.
W87-06532

USE OF CONCENTRATED MACRONUTRIENT SOLUTIONS TO SEPARATE OSMOTIC FROM NACL-SPECIFIC EFFECTS ON PLANT GROWTH,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.
For primary bibliographic entry see Field 2I.
W87-06535

ION REGULATION IN THE ORGANS OF CASUARINA SPECIES DIFFERING IN SALT TOLERANCE,
Australian National Univ., Canberra. Dept. of Forestry.
For primary bibliographic entry see Field 2I.
W87-06537

REDUCTION BY GA3 OF NACL-INDUCED INHIBITION OF GROWTH AND DEVELOPMENT IN SUAEDA USSURIENSIS,
Qufu Teachers Univ. (China). Dept. of Biology.
For primary bibliographic entry see Field 2I.
W87-06538

ROLE OF LEAF AREA DEVELOPMENT AND PHOTOSYNTHETIC CAPACITY IN DETERMINING GROWTH OF KENAF UNDER MODERATE SALT STRESS,
California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 2I.
W87-06539

3D. Conservation In Domestic and Municipal Use

ECONOMIC EVALUATION OF A REBATE PROGRAM FOR SAVING WATER: THE CASE OF MESA,
Arizona Univ., Tucson. Dept. of Economics.
D. E. Agthe, M. W. Garcia, and L. Goodnough.
Journal of Environmental Systems, Vol 16, No. 2, p 81-86, 1986-87. 5 ref.

Descriptors: *Economic aspects, *Water conservation, *Mesa, Arizona, *Cost-benefit analysis, *Public policy, Legislation, Legal aspects, Water policy, Conservation, Case studies.

In July of 1984, the City of Mesa, Arizona implemented a voluntary water development fee rebate program to encourage new home builders and owners to adopt water-saving desert landscaping. Results of a cost-benefit analysis suggest that the program was successful for single-family residences. It was also found that the program financially favors mul?;-family development over single-family residential housing. However, the program may not be sufficiently publicized and may not appeal to high-income home buyers. (Author's abstract)
W87-06007

CONSERVATION OF WATER IN MUNICIPALITIES,
Dallas City Water Utilities Dept., TX.
J. Stacha.
IN: Water Resources in Texas: The Need for a Water Research Agenda. Water Resources Symposium Number Eleven. University of Texas at Austin. Center for Research in Water Resources, 1984. p 213-220.

Descriptors: *Water conservation, *Municipal water, Public policy, Water use, Water use efficiency, Metering, Water costs.

Much has been written and discussed on the subject of water conservation. Now is the time to act. Municipalities must commence a well-rounded conservation effort that leads its citizens to a common sense point of view that simply does not tolerate wasting water. This effort must involve a good public information program, most importantly, one in which school children are involved; must develop sound metering and pricing systems supplemented by ordinances and building codes; must promote landscaping with low water use plants; and must encourage research on water reuse. Public interest and enthusiasm for this issue is not something that should be turned on and off like a faucet. It should be cultivated steadily and continuously through a variety of media, following a carefully planned program designed to achieve the desired results. (See also W87-06144) (Lantz-PTT)
W87-06158

RESIDENTIAL WATER DEMAND FORECASTING AND CONSERVATION PROGRAM ASSESSMENT: TWO ECONOMIC MODELS,
Pacific Gas and Electric Co., San Francisco, CA. Dept. of Economics and Forecasting.
For primary bibliographic entry see Field 6D.
W87-06256

SHORT-TERM FORECASTING OF MUNICIPAL WATER USE (WITH APPLICATION TO DROUGHT CONDITIONS),
Interstate Commission on the Potomac River Basin, Rockville, MD.
For primary bibliographic entry see Field 6D.
W87-06257

METER TESTING PROGRAM LEADS TO FAIR AND EQUITABLE WATER BUSINESS,
Moore and Kling, Inc., Northborough, MA.
For primary bibliographic entry see Field 6C.
W87-06548

METERING OF CONDOMINIUMS AND SUBDIVISIONS,
Portland Water District, ME.
For primary bibliographic entry see Field 6C.
W87-06549

METERING OF CONDOMINIUMS AND SUBDIVISIONS IN HAVERHILL, MASSACHUSETTS,
For primary bibliographic entry see Field 6C.
W87-06550

METERING OF CONDOMINIUMS AND SUBDIVISIONS,
Bridgeport Hydraulic Co., CT.
For primary bibliographic entry see Field 6E.
W87-06551

3E. Conservation In Industry

REMOVAL OF CHROMIUM FROM INDUSTRIAL EFFLUENTS BY ADSORPTION ON SAWDUST,
Roorkee Univ. (India). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W87-05940

ANAEROBIC DIGESTION OF STILLAGE FROM A PILOT SCALE WOOD-TO-ETHANOL PROCESS: I. STILLAGE CHARACTERISATION,
New Zealand Forest Service, Rotorua. Forest Research Inst.
For primary bibliographic entry see Field 5D.
W87-05954

ANAEROBIC DIGESTION OF STILLAGE FROM A PILOT SCALE WOOD-TO-ETHANOL PROCESS: II. LABORATORY-SCALE DIGESTION STUDIES,
New Zealand Forest Service, Rotorua. Forest Research Inst.
For primary bibliographic entry see Field 5D.
W87-05960

ANAEROBIC DIGESTION OF WOOL SCOURING WASTEWATER IN A DIGESTER OPERATED SEMI-CONTINUOUSLY FOR BIOMASS RETENTION,
Sydney Univ. (Australia). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5D.
W87-05976

OPERATION OF A LABORATORY-SCALE TUBULAR DIGESTER ON PIGGERY WASTE,
Polytechnic of Wales, Pontypridd. Dept. of Science.
For primary bibliographic entry see Field 5D.
W87-05977

STUDIES ON SYNTHESIS OF ION-EXCHANGE MEMBRANE FOR ELECTRODIALYTIC TREATMENT OF BLEACHING PLANT EFFLUENT,
Indian Inst. of Tech., Bombay. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5D.
W87-05985

CURRENT AND FUTURE ENVIRONMENTAL ISSUES AS SEEN FROM THE PRIVATE SECTOR,
ABC Research Corp., Gainesville, FL.
For primary bibliographic entry see Field 5G.
W87-06019

WATER CONSERVATION IN INDUSTRY,
Dow Chemical U.S.A., Freeport, TX. Texas Div.
W. F. McIlhenny.
IN: Water Resources in Texas: The Need for a Water Research Agenda. Water Resources Symposium Number Eleven. University of Texas at Austin. Center for Research in Water Resources, 1984. p 221-237, 5 fig, 7 tab, 13 ref.

Descriptors: *Industrial water, *Water conservation, *Texas, Water demand, Water supply, Water use, Saline water, Surface water, Water reuse.

Industry in Texas needs and uses relatively large amounts of water. In 1980, all Texas manufacturing required about 1,520,000 acre-ft or 8.5% of the total amount of water required for all uses in the state that year. Except for natural gas and pulp and paper mills (where other site considerations prevail) surface water, both fresh and saline, is the major source of water for Texas industry. Extensive use of saline water is restricted to the coastal zone where seawater or estuarine water is available. A high proportiion of the water withdrawn by industry is not consumed, but is used for once-through cooling and then discharged into a receiving water body. Because water is evaporated, and therefore consumed in a cooling tower, there is a direct relationship between the relative consumption of water and the relative use of cooling towers for heat rejection. This trend toward lessened use is evident throughout all manufacturing sectors. The reasons for this long-term trend toward less water use by all industries are complex and not immediately obvious. The emphasis on governmental regulation of the quantity and quality of effluents is reflected in a decline in the amount of new water taken in. Stricter internal controls have been applied by industry, and more efficient processes for separation and removal of constituents from water streams have been developed. As effluents became cleaner, they became reusable; less new water was required. Although industry in general has been responsive to a variety of pressures which tend to lessen the amount of water required per unit of production, there appears to be a minimum amount of water which will be required by each industry. The total annual water requirements for industry in Texas are estimated to reach a total of between 4,230,000 and 5,014,000 acre-ft in the year 2030. It is estimated that this need will grow more rapidly than the population. (See also W87-06144) (Lantz-PTT)
W87-06159

INDUSTRY AND THE ENVIRONMENTAL CHALLENGE,
For primary bibliographic entry see Field 5G.
W87-06197

3F. Conservation In Agriculture

SOIL WATER CONDITIONS AND YIELD OF TALL FESCUE, SWITCHGRASS, AND CAUCASIAN BLUESTEM IN THE APPALACHIAN NORTHEAST,
Science and Education Administration, University Park, PA. Northeast Watershed Research Center.
For primary bibliographic entry see Field 2G.
W87-05966

REDUCING SOIL EROSION IN TOBACCO FIELDS WITH NO-TILLAGE TRANSPLANTING,
North Carolina Dept. of Natural Resources and Community Development, Wilmington.
For primary bibliographic entry see Field 2J.
W87-05967

ASSESSMENT OF ENVIRONMENTAL IMPACTS OF SARDA SAHAYAK CANAL IRRIGATION PROJECT OF UTTAR PRADESH, GOVERNMENT, INDIA,
For primary bibliographic entry see Field 6G.
W87-05995

EFFECTS OF WATER APPLICATION RATES AND PLANTING DENSITY ON GROWTH PARAMETERS OF DRIP IRRIGATED ONIONS,
Puerto Rico Univ., Rio Piedras. Agricultural Experiment Station.
E. Caraballo, M. R. Goyal, and C. C. de Baez.
Journal of Agriculture of University of Puerto Rico, Vol. 70, No. 2, p 135-141. April 1986. 2 fig, 1 tab, 2 ref.

Descriptors: *Growth, *Irrigation effects, *Drip irrigation, *Application rates, *Onions, *Crop production, Mathematical analysis, Mathematical studies, Regression analysis, Irrigation, Leaves.

The effects of water application rates and planting densities were evaluated on growth parameters of drip irrigated onions in the semi-arid southern coast of Puerto Rico. Water application rates were wet, moist, and dry; planting densities were one row at 7.5 cm plant spacing, two rows at 7.5 cm, one row at 15 cm, and two rows at 15 cm. In all plots, fresh bulb weight, dry bulb weight, and bulb width were linearly correlated with days after transplanting. Quadratic curves described the relationships between other growth parameters (fresh plant weight, fresh total weight, plant height, number of leaves, dry plant weight, and dry total weight) with days after transplanting. No relationship was found between percent of total solids and days after transplanting. The coefficient of determination varied from 0.79 to 0.94, and the regression coefficients were significant at the 5% level. (Author's abstract)
W87-06004

DEVELOPMENT OF THE TWO-DIMENSIONAL INTERRILL FLOW COMPONENT FOR AGRICULTURAL RUNOFF MODELS,
Kansas Univ., Lawrence. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W87-06096

STUDY OF MANAGERIAL IRRIGATION COST ESTIMATION PROCEDURES,
Kansas Water Resources Research Inst., Manhattan.
For primary bibliographic entry see Field 6C.
W87-06101

CONSERVATION OF WATER IN AGRICULTURE,
High Plains Underground Water Conservation District, Lubbock, TX.
A. W. Wyatt.
IN: Water Resources in Texas: The Need for a Water Research Agenda. Water Resources Symposium Number Eleven. University of Texas at Austin. Center for Research in Water Resources, 1984. p 239-245.

Descriptors: *Agriculture, *Water conservation, Soil water, Soil horizons, Water extraction, Beef tallow, Irrigation practices, Tillage, Cloud seeding.

Various aspects of water conservation in agriculture are discussed. These are: (1) how much water the soil will hold at different horizons; (2) soil root zone extraction; (3) chemical hormones and plants; (4) beef tallow; (5) water extraction from soil; (6) irrigation scheduling; (7) tillage; (8) cloud seeding for rainfall enhancement; and (9) effective irrigation systems. Other aspects of agricultural conservation presented revolve around the recovery of groundwater from soils, and establishing surge systems for greater irrigation efficiency. (See also W87-06144) (Lantz-PTT)
W87-06160

MANAGEMENT OF ACID SULPHATE SOILS IN THE MUDA IRRIGATION SCHEME, KEDAH, PENINSULAR MALAYSIA,
Malaysian Agricultural Research and Development Inst., Serdang. Rice Research Branch.
For primary bibliographic entry see Field 5G.
W87-06174

IRRIGATION EFFICIENCIES,
International Inst. for Land Reclamation and Improvement, Wageningen (Netherlands).
M. G. Bos, and J. Nugteren.
International Institute for Land Reclamation and Improvement, P.O. Box 45, 6700 AA Wageningen, The Netherlands. ILRI Publication No. 19, 1983. 138 p, 20 fig, 14 tab, 10 photo, 4 append.

Descriptors: *Irrigation practices, *Irrigation efficiency, *Water use, Irrigation canals, Agriculture, Water transport, Irrigation management.

To estimate the effiency of water use in existing or future irrigation projects, the method described in this publication has proved very suitable. It consists of estimating separately the application, distribution, conveyance, tertiary unit and irrigation system efficiencies which, combined, give the project efficiency. An important aspect of the method is that it indicates steps that can be taken to improve system conditions or even to optimize them. In an irrigable area where the entire canal and ditch system operates at a near constant flow rate so that no division structures have to be manipulated, the only water losses will be due to

seepage. In all irrigated areas where either one main crop (other than rice) or a certain combination of crops is cultivated, the water supply must be adjusted, sometimes even frequently. A maximum conveyance efficiency with an average of about 0.88 can be attained if the size of the irrigable area is between approximately 4,000 and 6,000 ha. From the viewpoint of conveyance efficiency, the optimum size of a rotational unit (i.e. an irrigated unit commanded by a canal on intermittent flow) lies between 70 and 300 ha. It is further recommended that the main, lateral, and sublateral canals be operated on a schedule of continuous flow and that the area not be divided into subrotational units. During the entire season the flow rate in each of these canals should be solely a function of the wtaer requirement of the commanded area. (Lantz-PTT)
W87-06234

IRRIGATION REQUIREMENTS FOR DOUBLE CROPPING OF LOWLAND RICE IN MALAYA,
International Inst. for Land Reclamation and Improvement, Wageningen (Netherlands).
G. A. W. Goor, and G. Zijlstra.
International Institute for Land Reclamation and Improvement, P.O. Box 45, 6700 AA Wageningen, The Netherlands. ILRI Publication No. 14, 1983. 56 p, 17 fig, 17 tab, 15 ref, append.

Descriptors: *Irrigation requirements, *Double cropping, *Rice, *Malaya, Irrigation practices, Rainfall, Water supply, Soil saturation, Cultivation, Agriculture.

A stable and regular irrigation water supply and good water management are prerequisites for increasing rice production in the countries of South East Asia. The results of a study of irrigation water requirements for lowland wet rice cultivation in Malaya, both in the 'wet' main season and in the 'dry' off season are described. As rice cultivation and irrigation methods in most rice growing countries in Asia are more or less similar to those of Malaya, this study is believed to be of interest to many other countries as well. The investigation of the water balance in two test areas of 10 and 84 acres, as well as of the irrigation water supplied in three irrigation projects of 16,000, 4,500 and 4,100 acres with a pumped water supply, is described. Summarized are the rainfall characteristics of Malaya from the irrigation point of view. Factors determining the water requirements in rice fields are analyzed: water for evapotranspiration, for percolation, for establishing the water layer in the field and for saturation of the soil. Some measures to obtain efficient distribution of water and good water control in the off season are discussed. The prospects of doulbe cropping as a permanent system with regard to yield level and soil conditions are presented. Double cropping may lead to excessive reduction in the soil and decline in yields, especially on soils with a high organic matter content. Under these conditions regular aeration of the soil between crops is of the utmost importance. (Lantz-PTT)
W87-06235

MONO- AND DOUBLE-CROPPED WHEAT AND GRAIN SORGHUM UNDER RAINFED AND IRRIGATED CONDITIONS,
Sandyland Experiment Field, St. John, KS.
R. J. Crabtree, R. G. Greenland, S. O. Mehdawi, and P. L. Claypool.
Agronomy Journal AGJOAT, Vol. 78, No. 6, p 986-990, November-December 1986. 1 fig, 5 tab, 9 ref.

Descriptors: *Wheat, *Sorghum, *Cropping, *Irrigation effects, *Economic evaluation, *Crop yield, Rain, Tillage, Productivity, Food crops.

The present study was conducted at Bixby, Oklahoma, from 1980 to 1984, on a Wynona silt loam soil (Cumulic Haplaquolls) with 0-1% slope. Its objectives were to compare yields and net economic returns of mono- and double-cropped wheat and grain sorghum, where all wheat was produced under rainfed conditions and where mono- and double-cropped grain sorghum were produced under both rainfed and irrigated conditions. Over the 5-yr period, rainfed, monocropped wheat yielded an average of 3498 kg/ha compared to 2848 kg/ha for rainfed, double-cropped wheat. Irrigated, conventionally tilled, monocropped grain sorghum yielded an average of 5650 kg/ha compared to 4866 kg/ha for rainfed, conventionally tilled, monocropped grain sorghum. Irrigated, no-till, double-cropped grain sorghum yielded an average of 4976 kg/ha compared to 3856 kg/ha for rainfed, no-till, double-cropped grain sorghum. Rainfed, monocropped wheat produced the highest net economic return per hectare of any of the five cropping systems. Net return from rainfed, conventionally tilled, monocropped grain sorghum nearly equalled that from wheat. Irrigation increased the yields of mono- and double-cropped grain sorghum 784 and 1120 kg/ha, respectively. Given these yields, the price of grain sorghum would have to increase from 0.10 to 0.25 and 0.19 dollars/kg for mono- and double-cropped sorghum, respectively, before irrigation would become economically feasible. (Author's abstract)
W87-06397

EFFECTS OF WATER DEFICITS ON YIELD, YIELD COMPONENTS, AND WATER USE EFFICIENCY OF IRRIGATED CORN,
Agricultural Research Service, Bushland, TX. Conservation and Production Lab.
H. V. Eck.
Agronomy Journal AGJOAT, Vol. 78, No. 6, p 1035-1040, November-December 1986. 3 fig, 5 tab, 20 ref.

Descriptors: *Corn, *Irrigation effects, *Water use efficiency, *Crop yield, *Water deficit, Plant growth, Plant physiology, Evapotranspiration.

This paper reports: (1) the effects and timing and duration of water deficit periods on growth and yield components of corn; (2) evaluates the seasonal evapotranspiration requirements of corn; and (3) gives further information regarding the adaptation of corn for limited irrigation in a region of normally high evaporative demand climate (Bushland, Texas). In a 4-yr study, corn was grown under five irrigation treatments: adequate water, 2- and 4-wk water deficit periods during vegetative growth, and 2- and 4-wk water deficit periods during grain filling. Water deficits imposed 41 days after planting reduced leaf, stalk, and ear yields, whereas those imposed 55 days after planting reduced only stalk and ear yields. Deficits during vegetative growth reduced kernel numbers but had little effect on weight per kernel. Kernels were not affected by deficits during grain filling unless severe deficits were imposed early in the period; thus, grain yield reductions were proportional to reductions in weight per kernel. Without adequate water, seasonal water use averaged 964 mm on graded furrows and 834 mm in level borders. Although water use efficiency was sometimes increased slightly when plants were subjected to water deficits, limited irrigation of corn would not be feasible on the Southern High Plains. (Author's abstract)
W87-06398

EFFECT OF IRRIGATED AGRICULTURE ON GROUNDWATER,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 5B.
W87-06409

EFFECT OF IRRIGATION OF GROUNDWATER QUALITY IN CALIFORNIA,
Schmidt (Kenneth D.), Fresno, CA.
For primary bibliographic entry see Field 5B.
W87-06410

IRRIGATION EFFECTS IN ARIZONA AND NEW MEXICO, BY G. V. SABOL,
For primary bibliographic entry see Field 5B.
W87-06411

IRRIGATION EFFECTS IN OKLAHOMA AND TEXAS,
For primary bibliographic entry see Field 5B.
W87-06412

IRRIGATION EFFECTS IN SIX WESTERN STATES,
URS Corp., San Bernardino, CA.
For primary bibliographic entry see Field 5B.
W87-06413

MECHANICAL-HYDRAULIC DUAL-ACTING CONTROLLER FOR CANAL LEVEL OR DISCHARGE RATE,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 8C.
W87-06414

SOIL MOISTURE FLOW IN DRAINAGE-SUBIRRIGATION SYSTEM,
University Coll., Dublin (Ireland). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2G.
W87-06415

TRIANGULAR SIDE WEIRS,
National Inst. of Hydrology, Roorkee (India).
For primary bibliographic entry see Field 8B.
W87-06416

EFFECTS OF SEDIMENT-LADEN FLOW ON CHANNEL BED CLOGGING,
Montana State Univ., Bozeman. Dept. of Civil Engineering and Engineering Mechanics.
For primary bibliographic entry see Field 2J.
W87-06417

SIMULATING SPRINKLER PERFORMANCE IN WIND,
Tennessee Univ., Knoxville. Dept. of Agricultural Economics and Rural Sociology.
E. D. Vories, R. D. von Bernuth, and R. H. Mickelson.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 113, No. 1, p 119-130, February 1987. 4 fig, 1 tab, 18 ref.

Descriptors: *Irrigation efficiency, *Sprinkler irrigation, *Wind effects, *Model studies, *Mathematical equations, *Sprinklers, *Simulation, Simulation analysis, Sprinkling, Mathematical studies, Design standards, Irrigation, Prediction, Wetting pattern.

The uniformity of irrigation systems is important to efficiency, yield, and economics. Wind strongly affects this uniformity. A method is presented for simulating the operation of a sprinkler system in wind. Equations describing the motion of airborne water droplets are shown. The trajectories of water droplets ejected from a sprinkler were numerically computed. Composite results led to predictions of application patterns. Sprinkler droplet size distribution was used to predict the pattern around a sprinkler, and patterns were superimposed to represent a set (not continuously moving) system. Coefficients of uniformity were then computed. The model was validated by comparing predictions with observed application patterns. Individual and multiple sprinkler tests were compared. The simulation system appeared to be an effective predictor of sprinkler performance in wind. Use of this type of model can lead to improved sprinkler designs, although variability of the wind vector affects the accuracy of prediction. (Author's abstract)
W87-06418

CONJUNCTIVE USE IN SEVIER RIVER SYSTEM, UTAH,
Provo City Water and Wastewater Dept., UT.
For primary bibliographic entry see Field 4B.
W87-06419

EFFECT OF IRRIGATION MODERNIZATION ON GROUNDWATER BALANCE: SOUTH COAST OF PUERTO RICO,
G. L. Morris.
IN: Symposium on Tropical Hydrology and 2nd Caribbean Islands Water Resources Congress, Proceedings of the International Symposium, May 5-8, 1985, San Juan, Puerto Rico. p 16-19, 1 fig, 21 tab, 5 ref.

Descriptors: *Irrigation practices, *Groundwater budget, *Puerto Rico, Rainfall, Groundwater recharge, Alluvium, Sugarcane, Agriculture, Drip irrigation, Groundwater level.

Due to rain shadow effects, only 35 inches/yr of rain is received on Puerto Rico's narrow south coastal plain. Irrigation is required for most crops, including sugarcane, which has been produced as a monoculture on about 50,000 acres on the south coastal alluvium throughout most of this century. Groundwater balances indicate that irrigation pumping constitutes the predominate discharge from the aquifer, and that over 50% of all groundwater recharge is derived from the deep percolation of excess irrigation water. However, the acreage in sugarcane production is declining due to unprofitability, being supplanted in some areas by alternative crops using drip irrigation. Changes in cropping patterns and irrigation technology have focused on the coastal area of the Canas, Descalabrado and Coamo watersheds, between the towns of Santa Isabel and Juana Diaz. Drip irrigation systems have been installed on approximately 4,000 acres over the past eight years and installation on another 3,600 acres is planned, all supplied exclusively from groundwater. Surface water sources have been avoided because of intermittent supply and unacceptable water quality including sediment, aquatic weeds, plus household garbage and other debris which interfere with drip irrigation equipment. Irrigation technology on Puerto Rico's south coast cannot be upgraded by simply installing new technology on farms while ignoring the overall impact on the water budget. Having lost excessive storage capacity due to sedimentation it is now no longer feasible to operate the existing surface water system as if reservoir storage were still adequate. Rather, system operation should be reoriented to maximize the amount of groundwater recharge available from the Guayabal reservoir. This will permit groundwater storage to replace the reservoir storage which is being lost to sedimentation, thereby enabling acceptable levels of irrigation service to be maintained indefinately. (See also W87-06455) (Lantz-PTT)
W87-06459

FARM WATER REQUIREMENT,
National Univ. of Singapore. Dept. of Civil Engineering.
S. Y. Liong.
IN: Symposium on Tropical Hydrology and 2nd Caribbean Islands Water Resources Congress, Proceedings of the International Symposium, May 5-8, 1985, San Juan, Puerto Rico. p 125-128, 4 tab, 3 ref.

Descriptors: *Water use, *Farming, Agriculture, Irrigation practices, Evapotranspiration, Computer models, Model studies, Mathematical studies.

In the determination of farm water requirements, as a part of irrigation engineering, the work involved is very tedious and time consuming. Even in areas with the same climatic conditions, a great number of repetitive works are required to compute the farm water requirement for different types of crops planted at different times of the year. The objective of this paper is to describe a computer model which circumvents this seemingly endless repetition of computation for farm water requirements. Parameters used to compute the farm water requirement are: (1) reference evapotranspiration; (2) crop factors; (3) consumptive use; (4) cropping intensity; and (5) percolation. (See also W87-06455) (Lantz-PTT)
W87-06481

GLAUCOUSNESS IN WHEAT: ITS DEVELOPMENT AND EFFECT ON WATER-USE EFFICIENCY, GAS EXCHANGE AND PHOTOSYNTHETIC TISSUE TEMPERATURES,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.
For primary bibliographic entry see Field 2I.
W87-06531

EFFECT OF WATER STRESS ON NITROGEN NUTRITION OF GRAIN SORGHUM,
Queensland Univ., Brisbane (Australia). Dept. of Agriculture.
For primary bibliographic entry see Field 2I.
W87-06534

WATER USE, GRAIN YIELD AND OSMOREGULATION IN WHEAT,
New South Wales Dept. of Agriculture, Tamworth (Australia). Agricultural Research Centre.
For primary bibliographic entry see Field 2I.
W87-06536

SHOOT AND ROOT RESPONSE TO WATER DEFICITS IN RAINFED LOWLAND RICE,
International Rice Research Inst., Los Banos, Laguna (Philippines). Dept. of Agronomy.
For primary bibliographic entry see Field 2I.
W87-06540

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

INVOLVING HOMEOWNERS IN FLOOD MITIGATION,
New Orleans Univ., LA.
For primary bibliographic entry see Field 6F.
W87-06070

METROPOLITAN FLOOD LOSS REDUCTION THROUGH REGIONAL SPECIAL DISTRICTS,
Massachusetts Univ., Amherst. Dept. of Geology and Geography.
For primary bibliographic entry see Field 6E.
W87-06071

STORMWATER MANAGEMENT IN KANSAS: AN EVALUATION OF CURRENT PRACTICES,
Kansas Water Resources Research Inst., Manhattan.
B. M. McEnroe and, and R. L. Smith.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87 131769/AS, Price codes: A05 in paper copy, A01 in microfiche. Contribution No. 248, September 1985. 75 p, 8 fig, 1 tab, 26 ref, 3 append. Contract No. 14-08-0001-G907, Project No. USGS G907-23.

Descriptors: *Kansas, *Stormwater management, *Storm sewers, *Floodplain management, Stormwater, Flooding, Detention reservoirs, Urban areas, Urban hydrology, Technology.

This study had two objectives: (1) to evaluate the current stormwater management practices of Kansas cities and (2) to identify related technology transfer needs. Information was obtained from all Kansas cities with populations over 10,000. The following major issues are examined: (1) stormwater problems, (2) planning practices, (3) floodplain management, (4) detention policies, (5) technical criteria and state-of-the-art practices nationwide. Two noteworthy local programs are examined in detail. The report also responds to some of the technology transfer needs identified in the study. Some basic institutional and technical issues are reviewed, and the strengths and weaknesses of several hydrologic design methodologies are examined. (McEnroe-KS U.)
W87-06092

STUDY OF MULTIRESERVOIR OPERATION WITH MINIMUM DESIRABLE FLOW CONSTRAINTS,
Kansas Water Resources Research Inst., Manhattan.
For primary bibliographic entry see Field 6A.
W87-06093

PROBLEMS IN RECLAIMING AND MANAGING TIDAL LANDS OF SUMATRA AND KALIMANTAN, INDONESIA,
Euroconsult, Arnhem (Netherlands).
For primary bibliographic entry see Field 5G.
W87-06180

SNOTEL DATA ACQUISITION SYSTEM: A TOOL IN RUNOFF FORECASTING,
Soil Conservation Service, Portland, OR.
For primary bibliographic entry see Field 7B.
W87-06242

AUTOMATED DATA ACQUISITION TECHNIQUES FOR FORECASTING PACIFIC NORTHWEST RIVERS,
National Weather Service, Portland, OR. Northwest River Forecast Center.
For primary bibliographic entry see Field 7B.
W87-06243

EFFECTS OF RUNOFF FORECASTING ON COLORADO RIVER OPERATIONS AT HOOVER DAM,
Bureau of Reclamation, Boulder City, NV. Lower Colorado Region.
For primary bibliographic entry see Field 6B.
W87-06244

VALUE OF RAINFALL ESTIMATES IN RESERVOIR MANAGEMENT FOR FLOOD CONTROL,
Oklahoma Climatological Survey, Norman.
For primary bibliographic entry see Field 7B.
W87-06245

FLOOD FORECASTING FOR A POTENTIAL SPIRIT LAKE DEBRIS DAM BREAK,
National Weather Service, Portland, OR. Northwest River Forecast Center.
For primary bibliographic entry see Field 2H.
W87-06246

SOME ISSUES IN ASSESSING THE ACCURACY OF HYDROLOGIC FORECASTS,
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6B.
W87-06250

ANALYSIS OF SEASONAL VOLUME STREAMFLOW FORECAST ERRORS IN THE WESTERN UNITED STATES,
Soil Conservation Service, Portland, OR.
For primary bibliographic entry see Field 2E.
W87-06251

DEVELOPMENT OF INTEGRATED SURFACE AND GROUND WATER MANAGEMENT IN ILLINOIS,
Illinois State Environmental Protection Agency, Springfield. Div. of Land Pollution Control.
For primary bibliographic entry see Field 4B.
W87-06291

RIVER RESPONSE TO INTER-BASIN WATER TRANSFERS: CRAIG GOCH FEASIBILITY STUDY,
University of East Anglia, Norwich (England). School of Environmental Sciences.
R. D. Hey.
Journal of Hydrology JHYDA7, Vol 85, No 3/4, p 407-421, July 1986. 5 fig, 2 tab, 5 ref.

Descriptors: *Catchment areas, *Reservoir releases, *Rivers, *Erosion, *Craig Goch reservoirs, Flow, Stability, Sediment transport, Reservoirs, River basins, Watersheds, Basins, Storage.

Catchment development programs can significantly affect upland river stability. Changes in flow regimes and sediment transport rates occasioned by such activity can result in systematic erosion and deposition along the river. An investigation was carried out as part of Craig Goch reservoir development feasibility study on the effect of proposed releases from the reservoir on the stability of the rivers Wye, Dulas and Severn. Dominant discharge concepts indicate that regulation will not affect the natural stability of the channel provided that releases do not Increase the frequency of flows above bed material transport and bank erosion thresholds. Any increase in the frequency of such flows will cause unnatural instability. Standard field techniques were used to determine the critical threshold discharge for movement of the surface bed material. These data helped in the identification of the sections of channel which would experience erosion or deposition as a result of river regulation. Test releases from the Clywedog reservoir confirmed the results of the investigation on the river Severn. (Author's abstract)
W87-06308

EQUIVALENCE OF THE SEQUENT PEAK ALGORITHM AND THE LINEAR PROGRAMMING METHOD FOR DETERMINING THE CAPACITY OF A SINGLE RESERVOIR,
West Virginia Univ., Morgantown. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W87-06382

SOIL MOISTURE FLOW IN DRAINAGE-SUBIRRIGATION SYSTEM,
University Coll., Dublin (Ireland). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2G.
W87-06415

RUNOFF DISPOSAL IN THE LIMESTONE REGION OF NORTHERN P.R.,
Geotec, Caparra Heights, PR.
J. C. Agrelot.
IN: Symposium on Tropical Hydrology and 2nd Caribbean Islands Water Resources Congress, Proceedings of the International Symposium, May 5-8, San Juan, Puerto Rico. 1985. p 26-29, 2 fig, 6 ref.

Descriptors: *Storm runoff, *Urban runoff disposal, *Runoff, *Limestone, *Puerto Rico, Karst, Sinkholes, Aquifers, Storm water, Water quality control, Drainage.

The sinkholes and weathered limestone under the north coast karst terrain of Puerto Rico can be used as means of disposing storm water runoff. Nature has provided a landscape which can effectively collect and direct runoff into the underlying limestone aquifer. A number of projects have been built using one, or a combination of the described runoff disposal methods. Although these alternatives are successful in disposing of the storm water runoff, further consideration should be given to pollution control. Another recommendation is that further studies should be conducted on the capacity of a sinkhole or drainage well to drain water. This may reduce the need for using retention basins to compensate for the volume of water that exceeds the capacity of the sinkhole or drainage well. (See also W87-06455) (Lantz-PTT)
W87-06461

HYDROLOGIC SOLUTION FOR URBAN FLOODING IN TERESINA, BRAZIL,
J. Sanchez, and M. S. Lopes.
IN: Symposium on Tropical Hydrology and 2nd Caribbean Islands Water Resources Congress, Proceedings of the International Symposium, May 5-8, 1985, San Juan, Puerto Rico. p 109-113, 3 fig, 1 tab, 5 ref.

Descriptors: *Urban hydrology, *Teresina, *Brazil, *Flooding, *Flood control, Rainfall-runoff relationships, Flood hydrographs, Pumping, Flood damage, Urban planning.

The city of Teresina lies in the semiarid region of the Brazilian northeast and is periodically flooded due to intense rainfall, especially over some urban areas settled by low income populations, thus preventing normal economic activities over long time periods. This situation is partially caused by a protection dike along the Parnaiba River, which although it prevents the river from overflowing its banks, does not allow the rain water to run off freely. The problem is worsened by the fact that the subsoil consists of clay strata which practically eliminate infiltration and by the lack of a mechanism to pump off the water which has accumulated. Since it was considered that there was little likelihood of implementing a feasible pumping system for 44.5 cu m/sec, a comparative analysis was made to study the effects of a smaller capacity system allowing temporary flooding of sub-area 12 (which is the focal point of the problem), and which allows an estimate of the resultant damages caused by the inactivity period to which the affected population is subject. The results are presented, and the flood duration times are compared with and without damping, considering the pumping capacity available in the system. It is expected that this tool will render decision-making easier. (See also W87-06455) (Lantz-PTT)
W87-06478

AQUATIC BIOTA ASSOCIATED WITH CHANNEL STABILIZATION STRUCTURES AND ABANDONED CHANNELS IN THE MIDDLE MISSOURI RIVER,
Iowa Cooperative Fishery Research Unit, Ames.
G. J. Atchison, R. W. Bachmann, J. G. Nickum, J. B. Barnum, and M. B. Sandheinrich.
Available from the National Technical Information Service, Springfield, VA. 22161. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS. Technical Report E-86-6, July 1986. Final Report. 96 p, 8 fig, 26 tab, 54 ref.

Descriptors: *Channel stabilization, *Environmental effects, *Missouri River, *Aquatic life, Fish, Water quality, Abandoned channels, Dikes.

Biological and physical data were collected from main-stem habitats on the Missouri River between river miles 661 and 678 during 1983. Sampling was conducted to describe water quality and fish and benthic macroinvertebrate populations associated with dike, revetment, and abandoned channel habitats. Water quality measurements were rather uniform, except for some small occurrences between some measurements made in the abandoned channels and those in the main river, indicating a well-mixed system. Thirty-nine fish species comprised the juvenile and adult catch. The revetted bank samples were dominated by larger species, such as the blue sucker and flathead catfish. The dike field had a similar assemblage of larger species with blue sucker, channel catfish, flathead catfish, and goldeye predominating. The dike fields also provided habitat for a wide variety of minnows. The abandoned channels yielded the greatest species richness and overall greatest numbers of fish. The overall abundance of fish larvae in the abandoned channels was much higher than in the main channel and the catch was dominated by sunfishes and gizzard shad. The main channel habitats were found to be of importance for freshwater drum, carp suckers, and common carp. Peak times of larval fish abundance occurred between early June and mid-August. There were differences in the densities and taxonomic composition of the benthic invertebrate communities in the different habitats. The abandoned channel habitats were characterized by fine sediment particles, high benthos densities, and lower number of taxa than found on the rock substrate of the dikes and revetments. The dike pool habitats were characterized by high current velocities, a diversity of sediment types, and low benthic diversity. The dikes and revetments were similar in having large rock substrates and high current velocities. Attached forms such as Hydra were important as were other invertebrates commonly associated with coarse substrates (caddisflies, stoneflies, and clinging mayflies). (Author's abstract)
W87-06524

RESERVOIR SHORELINE REVEGETATION GUIDELINES,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
H. H. Allen, and C. V. Klimas.
Available from the National Technical Information Service, Springfield, VA. 22161. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS. Technical Report E-86-13, November 1986. Final Report. 87 p, 38 fig, 4 tab, 42 ref.

Descriptors: *Reservoirs, *Revegetation, *Standards, *Shoreline cover, *Lake Oahe, *Lake Texoma, *Lake Wallula, Economic aspects, Shore protection, Vegetation.

As part of the Environmental and Water Quality Operational Studies Program, three reservoirs were selected for investigating the feasibility of establishing vegetation on shorelines subject to varying water levels. Study sites were established at Lake Oahe, South Dakota; Lake Texoma, Oklahoma/Texas; and Lake Wallula, Oregon/Washington. This report synthesizes the results of the revegetation trials at these study sites and pertinent revegetation concepts reported elsewhere. Guidelines for developing vegetation on reservoir shorelines having fluctuating water levels are presented in five parts: (a) planning, (b) site preparation, (c) planting, (d) post-planting operations and maintenance, and (e) costs. Emphasis is placed on reduced costs, proper planning, procurement of plant materials, appropriate planting times and methods, and special planting techniques for erodible shorelines. (Author's abstract)
W87-06527

ALGICIDAL PROPERTIES OF ACACIA NILOTICA,
Agricultural Research Council, Khartoum (Sudan). Dept. of Phytochemistry.
S. M. H. Ayoub.
Aquatic Botany AQBODS, Vol. 23, No. 4, p 389-390, February 1986. 3 ref.

Descriptors: *Algicides, *Algal control, *Acacia, *Biological weed control, Artificial ponds, Algae, Tannins, Pesticides, Weed control, Sudan.

The algicidal activity of aqeuous extracts of the pods of Acacia nilotica was tested in artifical ponds. Addition of 20-40 ppm of the extract caused complete disappearance of the algae within 4 days; concentrations of 60-100 ppm caused the same in 3 days; concentrations of 120-200 ppm had the same result in 2 days. Algae belonging to the genera Rivularia, Oscillatoria, Spirulina, Chroococcus, Microcystis, Pediastrum, Coelastrum, Spirogyra, Cosmarium, Closterium, Euglena, and Cyclotella were successfully controlled with this extract. (Authors's abstract)
W87-06599

HISTORY OF THE RECLAMATION OF THE WESTERN FENLANDS AND OF THE ORGANIZATIONS TO KEEP THEM DRAINED,
Vrije Univ., Amsterdam (Netherlands). Faculty of Law.
H. van der Linden.
IN: Proceedings of the Symposium on Peat Lands Below Sea Level, August 24-28, 1981, The Netherlands. IRLI Publication No. 30, 1982. p 42-73, 8 fig, 15 ref.

Descriptors: *Land reclamation, *Fens, *Holland, *Drainage practices, *Polders, Peat bogs, Drainage programs, Drainage systems, Surface drainage, Drainage districts, Drainage canals, Drainage patterns, Drainage ditches, History, Political aspects, dikes, Dunes, Dams, Sluices, Jurisdiction.

The fossil coastal barriers behind the dunes in the north of Holland were already settled in the 8th century AD. The wild fenlands in the province of North Holland were occupied by the second half of the 10th century as evidenced by the payment records of bodding (taxes) to the count. Land

reclamation at this time was by means of drainage ditches. The Holland-Utrecht lowland plain was thought to have been reclaimed in the 11th and 12 centuries by a system of localized dikes and sluices. Dutch immigrants brought their system of parcellization for settlement and land reclamation to Germany in the earlier part of the 11th century. The discovery that grain could grow in the fenlands paved the way for the Big Reclamation which lasted until the 14th century. After 1150 AD, the water problems of the plain required the construction and maintenance of large regional waterworks. This, coupled with the disappearance of wild fenland brought about the need for a more elaborate social structure and taxation system. In the 12th century, regional waterboards came into existence to maintain dikes, dams and drainage ditches. Cooperation between waterboards was evident during the 13th century. During the 14th, 15th, and 16th centuries the more powerful waterboards took over the supervision of the local waterboards. By the 14th century most of the waterboards had official charters to fulfill their duties. The late Middle Ages saw the second manifestation of the Dutch waterboard: the polder. Polders, a group of lands brought together by the need for better drainage, could be judicial or technical in nature. The polders created their own laws and grew in importance up to the 20th century. Drainage windmills introduced in the 15th century helped to reclaim more land, some from the big lakes in North Holland, for the polders. Changes in the Dutch constitution in 1840 shifted power from the waterboards to the provincial government. The idea of organizing the lower authorities on a larger scale has grown since the end of World War II. (See also W87-06622) (Geiger-PTT)
W87-06625

COMPARATIVE NOTE ON THE EXPLOITATION AND DRAINING OF THE PEAT FENS NEAR THE WASH,
J. R. Ravensdale.
IN: Proceedings of the Symposium on Peat Lands Below Sea Level, August 24-28, 1981, The Netherlands. IRLI Publication No. 30, 1982. p 74-84, 1 fig, 18 ref.

Descriptors: *Fens, *Land reclamation, *Peat bogs, *Polders, *Drainage practices, Drainage effects, Peat soils, Peat, Drainage canals, Drainage programs, Drainage ditches, Surface drainage, History, Political aspects, Agriculture, Bogs, Farming, Pastures, Drainage patterns.

Settlement of the fenlands of the Wash was not extensive until the 10th century AD. Details of land reclamation are found in seigneurial records. Use of the fens as pasturelands led to their later suitability for farmlands. As draining became increasingly effective, and as drying fen was cleared, shrinkage and wastage of peat accelerated. As the supply of peat continued to shrink, more water had to be lifted from fields into rivers that now ran above them. The use of windmill pumps proliferated by the 17th century. From the Lynn Law of 1630, through the Pretended Act of 1649, to the General Draining Act of 1663, a unified and comprehensive scheme for draining seemed possible. Before the middle of the 18th century, local internal drainage boards were being set up by Parliament with authority equivalent to that in polders. In recent years, a series of measures have reorganized drainage authorities, setting up first river catchment boards, and finally Regional Water Authorities. The rate of disappearance of the peat depends partly on the effectiveness of the drainage to which it is subjected, and the method of husbandry used. Archaeological work suggests that the fenlands of Englnad contain a type of earthwork which most likely resulted from planned reclamation in the 13th century. Drainage districts contain a scale smaller than the blocks produced by the Dutch-Frisian system. The pattern is that of a large area of reclaimed land added on to an older arable system. (See also W87-06622) (Geiger-PTT)
W87-06626

WATER MANAGEMENT IN THE WESTERN NETHERLANDS,
Agricultural Univ., Wageningen (Netherlands).
W. H. van der Molen.
IN: Proceedings of the Symposium on Peat Lands Below Sea Level, August 24-28, 1981, The Netherlands. IRLI Publication No. 30, 1982. p 106-121, 7 fig, 6 ref.

Descriptors: *Land reclamation, *Peat bogs, *Polders, *Water management, *The Netherlands, Lakes, Peat soils, Surface drainage, Pumping, Drainage ditches, Drainage canals, Peat, Drainage practices, History, Water level, Dikes, Dams, Bogs, Subsidence.

The water management system of the Western Netherlands is almost entirely artificial and extremely complicated. In Roman times, few people lived in this area, most of them along the main rivers Oude Rijn and Vecht. In the 10th century, colonization of the area took place after the construction of drainage ditches. When the Oude Rijn river became clogged around the year 1150 AD, the drainage of the area was disturbed and a dam was built to block the discharge of the upstream lands. Around 1200, dams and dikes were built along the coast with sluices to provide drainage at low tide. The unified system of former rivers, natural lakes and canals was known as a boezem. As more peat was reclaimed and subsidence (a lowering of the land level) increased, drainage in the boezems became more difficult. Polders were established with water levels lower than the boezems. Windmills were used extensively to pump water by the 15th century. Peat provided the growing cities with fuel up until the 20th century. Where peat was extensively farmed, small lakes or plas were formed. The meer or natural lakes acted as a large store during times of excess water in the boezem system. Windmills operating in series were used to drain both natural and artificial lakes to increase farmlands. Draining the natural lakes decreased the storage capacity of the boezem. The artificial reopening of the Oude Rijn near Katwijk provided compensation for the lost storage capacity that resulted from draining the Haarlemmermeer. As a result of this long historical development three groups of water management systems have emerged: tile-drainage of the deep polders; drainage ditches of the grassland polders, and pumping stations of the boezem. (See also W87-06622) (Geiger-PTT)
W87-06628

WATER MANAGEMENT OF NORTHWESTERN GERMAN PEATLANDS,
Niedersaechsisches Landesamt fuer Bodenforschung, Bremen (Germany, F.R.). Bodentechnologisches Inst.
R. Eggelsmann.
IN: Proceedings of the Symposium on Peat Lands Below Sea Level, August 24-28, 1981, The Netherlands. IRLI Publication No. 30, 1982. p 122-129, 4 fig, 2 tab, 5 ref.

Descriptors: *Water management, *Land reclamation, *Peat bogs, *Germany, *Surface drainage, Sluices, Peat soils, Soil profiles, Bogs, History, Drainage ditches, Fens, Cultivation, Water table, Drainage practices, Subsidence, Dikes, Pumping, Subsoil, Sea level, Land use.

In Northwestern Germany, peatland reclamation began some centuries later than in The Netherlands. Three different water management strategies are defined for the three typical peat areas of this region. In the non-cutover raised bog which lies between Hamburg and Bremen, the first shallow drainage took place around 1875 in connection with railway construction. Drainage with tile drains was established by the early 20th century when fields were used for pasture and farming. In the 1930's, sand-mixed cultivation took place with Dutch fen cultivation or deep ploughing. In the 1960's, small pumping stations were established and deep ploughing of shallow peat layers was practiced. In the southeastern part of the Dutch-German peat district Bourtanger Moor, the raised bogs of the Twist and Schoeninghsdorf contain slightly decomposed Sphagnum peat above strongly decomposed Sphagnum peat. In 1875, the South-North-Channel was constructed for drainage and shipping. In 1890, open ditches and German raised bog cultivation for farming took place in the Schoeninghsdorf; industrial peat cutting for fuel, litter and soil improvement was practiced in the Twist. Low moor (fen) and raised bog profiles are found in Moorriem near the county town Brake at the river Weser between the North Sea and Bremen. In 1880, drainage by sluices became better, and German raised bog cultivation for farming was begun. By 1950, grassland for pasture was preferred after subsidence and oxidation occurred. In 1955, a main pumping station for drainage along the dikes, and substations for subdrainage were constructed. Subdrainage with tile drains occurred in 1960 and subdrainage with PVC-drains took place in 1970. For peat grassland a water table in spring of between 60 and 80 cm below soil surface is required. For sand-mixed cultivation a ditch water-level of 20 cm below deep plough furrow in the sand subsoil is needed. In the last few decades in peat grassland, the peat density has been compressed by subsidence, traffic with farm machinery, and dairying. Peatlands without agricultural use and high bogs are now protected by nature conservation measures. (See also W87-06622) (Geiger-PTT)
W87-06629

DRAINAGE AND BEHAVIOUR OF PEAT SOILS,
Instituut voor Cultuurtechniek en Waterhuishouding, Wageningen (Netherlands).
C. J. Schothorst.
IN: Proceedings of the Symposium on Peat Lands Below Sea Level, August 24-28, 1981, The Netherlands. IRLI Publication No. 30, 1982. p 130-163, 17 fig, 11 tab, 6 ref.

Descriptors: *Peat soils, *Peat bogs, *Drainage practices, *Soil water, *Soil-water-plant relationships, Subsidence, Peat, Agriculture, Drainage ditches, Drainage programs, Nitrogen, Fertilizers, Water level, Surface drainage, Moisture tension, Soil moisture retention, Irrigation effects.

Drainage experiments were carried out on the western peat area of the experimental farm of the Regional Research Center for Cattle Husbandry at Zegveld. The program of investigation included the following items: relation of groundwater and ditch water level; relation of bearing capacity, depth of groundwater level, moisture content and moisture tension; gross dry matter yield at different nitrogen applications for shallowly drained and well-drained soils; nitrogen uptake by the grass crop; moisture uptake of the crop; subsidence of the soil surface and of different soil tiers in connection with the depth of drainage; and the effect of drain depth on net yield. Results showed that the main problem of the western peat area is the bearing capacity of the topsoil in wet periods because of increased mechanization and intensification of dairy farming over the last few decades. Bearing capacity could be improved by lowering the ditch water levels to 70 to 100 cm below the surface. The deeper drainage gives a better aeration of the topsoil and favors the natural nitrogen uptake from soil to a great extent, resulting in higher yields of dry matter and protein and an earlier grazing yield in spring. However, deeper drainage causes a faster decomposition of organic matter which leads to a reduction in soil volume and subsidence of the surface. Another disadvantage of deeper drainage is desiccation of the root zone in very dry summers. When normal weather conditions resume, rewetting of the topsoil is a slow process because of a quick discharge of precipitation to the subsoil in the ditch. The required moisture content of the root zone can be restored by sprinkler or flood irrigation combined with a temporarily high ditch water level. (See also W87-06622) (Geiger-PTT)
W87-06630

URBAN USE OF PEAT SOILS,
J. van den Kerkhoff.
IN: Proceedings of the Symposium on Peat Lands Below Sea Level, August 24-28, 1981, The Netherlands. IRLI Publication No. 30, 1982. p 169-206, 20 fig, 6 ref, 2 append.

Descriptors: *Peat soils, *The Netherlands, *Urbanization, *Urban hydrology, *Land reclamation,

Soil mechanics, Land use, Urban planning, Surface drainage, Structural settlement, Sewer systems, Pipelines, Road construction, Bridge construction, Construction methods, Peat bogs.

Reclamation of peat soils in The Netherlands started at the banks of rivers on the clay levees. Population growth in Europe from 900 to 1300 AD caused rapid reclamation of waste land. Soils used for growing crops were improved with mud from drainage ditches, manure, sands, calcareous clay, and wastes from the towns. In the 15th century people passed into poldering and draining by means of windmills. As peat was used for fuel, large lakes were formed which were later reclaimed for urban develpment. To judge the fitness of the soil for building, soil mechanics factors of consolidation, secular effect, compression, and grain stress must be considered. In peat soils, the increase of loading can be taken up by peat fibers if the structure has grown compact. To improve peat areas for building, the groundwater level may be decreased or the ground level raised. Road construction may take place on piles (fixed system) or by combining the subsoil with sediments (floating system). To limit the size of the sewers in peat areas, the divided system is used. Low weight PVC pipelines are used without foundation and the sewerage can go along with the subsidence of the whole site. When placing pipes for the transportation of gas and drinking water, problems occur with transportation of the pipes, loss of soil, stability of the trench, lifting of pipes, and the filling of the trench. To prepare recreational fields on peat lands, the peat soils must be modified to increase bearing capacity. For building construction, concrete piles or wooden piles with concrete caps are used. In soil with a good shear resistance, soil retaining constructions may be anchored to the soil by means of anchor plates. Concretes and steels usually have a protective coating to prevent attack from acidic peat groundwater. Some restrictions on urban development have been made for the rural areas around Holland-Utrecht. Several peat areas have been designated as potential national parks. (See also W87-06622) (Geiger-PTT)
W87-06631

USE OF PEAT SOILS FOR GRASSLAND,
Centre for Agrobiological Research, Wageningen (Netherlands).
T. A. de Boer.
IN: Proceedings of the Symposium on Peat Lands Below Sea Level, August 24-28, 1981, The Netherlands. IRLI Publication No. 30, 1982. p 214-227.

Descriptors: *Peat soils, *Land reclamation, *Grasslands, *Peat bogs, *Land use, Surface drainage, Grasses, Polders, Fertilization, Hay, Peat, Vegetation, Pastures, Minerals, Grazing, Cattle, Drainage ditches, Nesting, Wildlife habitats, Wildlife conservation, Nitrogen, Drainage canals.

Thousands of years ago, cattle were grazed in open places between the wooded peat land. As land reclamation became more organized, polders became common, with wind mills to pump water. Grasslands were fertilized with stable manure. Because of the migration of minerals from the hayfields via the cows and their dung to the pastures a rather high phosphate and potash level in the soil was achieved and a good production was possible. Changes in the humidity of the organic matter during the year fostered nitrate mineralization which also influenced production. With the introduction of motor pumps, the groundwater level could be more easily controlled and wagons could travel a greater distance from the farm house to deliver fertilizers to distant hayfields. Different grass species replaced the blue grasslands. From 1960 to the present, the amount of nitrogen in fertilizer has increased promoting the adoption of the mixed use-system; hay is used less as fodder. Knowledge of fertilizer application is necessary to prevent over-dosing and exploitation of the grasslands. Vegetation surveys have been used for nature and landscape management. To safeguard bird nesting areas in peat districts, plans are underway to reduce the amount of land drainage and to restore the former haypasture vegetation. A review of the chapter compares the development of the Irish peatlands with those of The Netherlands. The Irish peatlands were not as important as pasturelands because they were mostly bogs of the blanket and raised type that were less productive than those in The Netherlands. (See also W87-06622) (Geiger-PTT)
W87-06632

FARM MANAGEMENT ON PEAT SOILS,
Advisory Service for Matters Relating to Soil Science in Agriculture, Wageningen (Netherlands).
C. B. H. Schneider.
IN: Proceedings of the Symposium on Peat Lands Below Sea Level, August 24-28, 1981, The Netherlands. IRLI Publication No. 30, 1982. p 228-240, 1 fig, 11 tab, 8 ref.

Descriptors: *The Netherlands, *Peat soils, *Dairy industry, *Surface drainage, *Farm management, Drainage practices, Grasses, Peat bogs, Peat, Hay, Grasslands, Soil types, Sand, Loam, Clay loam, Land reclamation, Organic soils, Land use, Drainage ditches, Fertilizers, Pastures.

Of the total area of agricultural land in the The Netherlands, 17% is situated on peat soil and mainly used as grassland. In the last two decades, the number of dairy farms has decreased by 60% while the total number of dairy stock has increased by 40%. The cubicle house is used for housing dairy cattle and farms are in parcels. On many holdings over 15% of the total surface consists of water. Drainage of the grasslands is insufficient for about 50% of the peatland area. Difficulties often arise with the load bearing capacity of the grasslands during the winter and spring. Slurry may be spread over the land only when the ground is frozen. To harvest the first crop of cut grass at the end of April, the nitrogenous fertilizer must be spread around the middle of March. Problems of insufficient bearing capacity do not generally occur as frequently on sandy soils. On peat soil farms hay winning is predominant over silage. In general, larger farms have a higher level of return on labor and therefore a larger family income. The peat soil pasture district is lagging behind slightly in profits in comparison to the sandy soil district. The grass production of the peat soil grassland is higher than the production of the sandy soil grassland due to the nitrogen production by peat. The latest developments in specialization have been adopted more readily by the sandy soil farms than the peat soil holdings. (See also W87-06622) (Geiger-PTT)
W87-06633

FUNDAMENTALS OF THE THEORY OF PEAT DEPOSIT DRAINING,
All-Union Scientific Research Inst. for the Peat Industry, Leningrad (USSR).
For primary bibliographic entry see Field 2G.
W87-06636

4B. Groundwater Management

COLLECTED REPRINTS, VOLUME V: 1978-1981.
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
June 1984. Compiled by Faith N. Fujimura and April W. L. Kam. 362 p. Contract No. CT371300, Project No. 371322.

Descriptors: *Hawaii, *Water resources development, *Reviews, Solar radiation, Groundwater recharge, Urban runoff, Flash floods, Wastewater irrigation, Wastewater disposal, Bioindicators, Hydraulic structures, Models, Water supply.

The fifth volume (1978-1981) of the Collected Reprints series updates information available in earlier volumes (I-IV, 1966-1977) of research by Water Resources Research Center faculty and principal investigators. The collection of journal reprints and conference and information papers provides a handy reference volume of water research articles, some of which are not available in public collections. Topics dealing with water resources research in Hawaii include: solar radiation, diurnal rainfall variability, direct interception of cloud and fog water, urban storm water runoff, emergent tropical marsh vegetation, flash-flood meteorology, reuse of treated sewage for sugarcane irrigation, groundwater recharge, conservation economics of water rights, waste injuection models, poliovirus inactivation by bromine chloride and chlorine, soil hydraulic conductivities, sunlight effect on survival of indicator bacteria in seawater, sunlight variation induced by topography under a tradewind regime, rainwater cistern vs. public water supply systems, water rights cases, storm runoff impoundment, marine pollution monitoring, effluent irrigation of California grass and nitrogen removal, and automatic opening structure for sediment-plugged stream mouths. Author and subject indexes are included with the compilation of 44 papers. (See also W87-06104 thru W87-06125) (Geiger-PTT)
W87-06103

GROUNDWATER RECHARGE ASPECTS FOR AN ISLAND ENVIRONMENT,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
L. S. Lau, and G. L. Dugan.
IN: Collected Reprints, Volume V: 1978-1981, June 1984. Water Resources Research Center, Honolulu, Hawaii. p 76-86, 1 fig, 3 tab, 5 ref.

Descriptors: *Groundwater recharge, *Wastewater irrigation, *Water demand, *Artificial recharge, *Water reuse, Water supply development, Wastewater disposal, Leachates, Water supply, Land disposal, Wastewater renovation, Wastewater farming.

The Hawaiian island of Oahu's water demand is projected to equal its fully developed freshwater supply by the year 2000. The only practical means for supplementation may be wastewater reuse and reclamation. An ongoing project started in 1971 by the University of Hawaii Water Resources Research Center (WRRC) has been studying the various aspects of applying secondary sewage effluent for irrigating grassland and sugarcane. Groundwater recharge data was generated through measurements from four lysimeters. Results showed that the application of secondary sewage effluent to grassland and sugarcane had no detrimental effect on the vegetation or public health. It served as a fertilizer source and as a sewage disposal method. The quality of leachate below the root zone was similar to that obtained with conventional agricultural practices. At least 50% of the applied liquid reached the groundwater. (See also W87-06103) (Geiger-PTT)
W87-06108

COORDINATED USE OF GROUNDWATER AND SURFACE WATER IN TEXAS,
Texas Dept. of Water Resources, Austin. Planning and Development Div.
For primary bibliographic entry see Field 6D.
W87-06153

EFFECT OF WATER MANAGEMENT ON FIELD PERFORMANCE OF OIL PALMS ON ACID SULPHATE SOILS IN PENINSULAR MALAYSIA,
Harrisons and Crosfield (Malaysia), Kuala Lumpur.
For primary bibliographic entry see Field 5G.
W87-06179

DEVELOPMENT OF INTEGRATED SURFACE AND GROUND WATER MANAGEMENT IN ILLINOIS,
Illinois State Environmental Protection Agency, Springfield. Div. of Land Pollution Control.
D. A. Crandall.
IN: Options for Reaching Water Quality Goals, Proceedings of the Twentieth Annual Conference of the American Water Resources Association Symposium, Washington, DC., August 15, 1984. 1985. p 193-199, 7 fig, 8 ref.

Descriptors: *Water quality control, *Illinois, *Groundwater pollution, *Water pollution control,

*Surface-groundwater relations, Surface water, Water quality management, Groundwater quality.

The Illinois Environmental Protection Agency carried out a multi-year effort to study the integration of surface and groundwater management. Five studies in this national prototype project under Section 208 of the Federal Water Pollution Control Act were funded at the Illinois State Water Survey, the Illinois State Geological Survey and in-house to understand better the technical aspects of surface and groundwater interrelationships. These studies developed: (1) information on the discharge of groundwater from facilities with NPDES permits; (2) maps of groundwater quality and a study relating the mapped data to surface water quality for the Mackinaw River Basin; (3) information relating oil field brine and surface water quality; (4) a detailed survey of information related to surface and groundwater management in the Sangamon River Basin; and (5) state-wide maps of aquifer susceptibility to contamination. An additional study involved an institutional assessment of groundwater management. Information developed in the technical studies provided a basis for including measures relating surface and groundwater management in the proposed groundwater strategy for Illinois. Specific measures developed in the proposed strategy include delineation of critical recharge areas and imminent return-flow areas. (See also W87-06270) (Author's abstract)
W87-06291

DISCRETE KERNEL SIMULATION MODEL FOR CONJUNCTIVE MANAGEMENT OF A STREAM-AQUIFER SYSTEM,
Colorado Univ. at Boulder. Dept. of Civil, Environmental, and Architectural Engineering.
T. H. Illangasekare, and H. J. Morel-Seytoux.
Journal of Hydrology JHYDA7, Vol 85, No 3/4, p 319-338, July 1986. 7 fig, 1 tab, 36 ref.

Descriptors: *Model studies, *Water management, *Conjunctive use, *Acquifers, Water use, Simulation, Groundwater basins, Streams, Streamflow, Flow, South Platte River, Colorado.

A stream-acquifer simulation model was developed to conduct a conjunctive use management study in the South Platte River in Colorado. The physical and operational behavior of the system was simulated. The physical system modeled was comprised of the river and the saturated and unsaturated zones of the aquifer. A technique referred to as the 'discrete kernel approach' was used to model the saturated zone of the aquifer. The classical Green's function method of solution of partial differential equations was the base for this technique. The physical simulator was coupled to an allocation model which simulated the operational behavior of the system. The management model was applied to conduct a conjunctive use study involving the evaluation of a stream flow augmentation scheme. The results showed that this was not the best plan because the the damages due to pumping were not fully compensated. (Author's abstract)
W87-06302

CONJUNCTIVE USE IN SEVIER RIVER SYSTEM, UTAH,
Provo City Water and Wastewater Dept., UT.
C. H. Carpenter.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 113, No. 1, p 131-140, February 1987. 8 fig, 8 ref.

Descriptors: *Groundwater management, *Sevier River, *Groundwater irrigation, *Irrigation, *Utah, *Conjunctive use, *Groundwater availability, *Groundwater basins, *Groundwater, Available water, Water management, Groundwater potential, Sevier Desert, Sanpete Valley, Basins, Surface water, Wells, Overdraft, Water use, Water rights, Legal aspects, Pumping.

The Sevier Desert and Sanpete Valley are two subbasins within the Sevier River System in south-central Utah in which groundwater is extensively used in conjunction with surface water for irrigation. The conjunctive use has developed more by accident than by deliberate planning. The surface-water supply in the two areas was basically developed by 1920. Severe droughts in the early 1920s and early 1950s focused attention on groundwater development as a supplemental supply. Well construction gradually increased between the mid-1940s and 1960 in both basins until the problems of water rights and overdraft essentially halted further development. Groundwater pumpage in both the Sevier Desert and Sanpete Valley has fluctuated inversely with the available surface-water supplies and climatic conditions. Overdraft has not occurred and the sustained yield of the groundwater basins seems to have been established. (Author's abstract)
W87-06419

GROUNDWATER QUALITY AND MANAGEMENT: RESEARCH AND EXTENSION.
Cornell Univ. Agricultural Experiment Station, Ithaca, NY.
For primary bibliographic entry see Field 5G.
W87-06451

ESTIMATING THE CAPACITY OF A SALTY LIMESTONE AQUIFER IN PUERTO RICO TO RECEIVE, STORE, AND RELEASE INJECTED FRESHWATER USING CHLORIDE MASS BALANCE,
D. V. Whitesides, V. Quinones-Aponte, and A. Zack.
IN: Symposium on Tropical Hydrology and 2nd Caribbean Islands Water Resources Congress, Proceedings of the International Symposium, May 5-8, 1985, San Juan, Puerto Rico. 1985. p 50-55, 3 fig, 1 tab, 3 ref.

Descriptors: *Aquifers, *Limestone, *Puerto Rico, *Chlorides, *Water storage, Mathematical studies, Injection wells, Conductivity, Saline water.

The feasibility of storing excess streamflow through artificial recharge in a salty aquifer in north-central Puerto Rico was investigated. Chloride mass balance analyses of the injected and recovered water were used to estimate recovery yields. Injection rates of 600 gal/min were achieved. Recovery rates ranged from 5-26% of the water injected. However, only about 40% of the recovered mix was below a suitability limit of 2,000 microsiemens/cm of specific conductance and 500 mg/L of chloride. The recovered water exceeded the suitability limits after a short residence time in the aquifer. (See also W87-06455) (Author's abstract)
W87-06466

WATER QUALITY AND CHEMICAL EVOLUTION OF GROUND WATER WITHIN THE NORTH COAST LIMESTONE AQUIFERS OF PUERTO RICO,
For primary bibliographic entry see Field 2F.
W87-06467

DEVELOPMENT OF A FRESH WATER SUPPLY FROM THE WATER-TABLE AQUIFER ON A BARRIER ISLAND,
Geological Survey, Tuscaloosa, AL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W87-06469

APPLICATION OF A GROUND-WATER FLOW DIGITAL MODEL IN EVALUATING ALTERNATE DEWATERING SYSTEMS IN THE RIO GRANDE DE ARECIBO ALLUVIAL VALLEY, PUERTO RICO,
V. Quinones-Aponte, and H. Torres-Sierra.
IN: Symposium on Tropical Hydrology and 2nd Caribbean Islands Water Resources Congress, Proceedings of the International Symposium, May 5-8, 1985, San Juan, Puerto Rico. p 129-134, 6 fig, 2 ref.

Descriptors: *Model studies, *Groundwater movement, *Rio Grande de Arecibo, *Alluvial rivers, *Puerto Rico, *Dewatering, Flow profiles, Landfills, Flow patterns.

A three-dimensional finite-difference groundwater flow model was constructed and calibrated to evaluate alternate dewatering systems for a construction landfill. The calibration of the model was made in four phases, beginning with a nonstress steady-state simulation and advancing in complexity to transient simulations. Two different dewatering systems, a well-points field, and an underground pipe drain were tested with the model. The drain proved to be more efficient than the well-points field in dewatering the landfill around the perimeter of a rice mill basement. (See also W87-06455) (Author's abstract)
W87-06482

4C. Effects On Water Of Man's Non-Water Activities

EVALUATION OF URBAN DEVELOPMENT IMPACT ON STORM RUNOFF BY DIGITAL COMPUTER,
Hawaii Univ. at Manoa, Honolulu. Dept. of Civil Engineering.
Y. S. Fok, and E. T. Murabayashi.
IN: Collected Reprints, Volume V: 1978-1981, June 1984. Water Resources Research Center, Honolulu, Hawaii. p 206-215, 4 fig, 6 ref.

Descriptors: *Urban runoff, *Urbanization, *Storm runoff, *Computer models, *Simulation analysis, Land use, Infiltration, Runoff, Seepage, Surface runoff, Storm water, Urban drainage, Urban planning, Hydrographs.

The impact of urban development on storm runoff has been evaluated by means of the St. Louis Watershed Model, a modified ILLUDAS model. Using storm runoff data obtained from an experimental watershed in Mililani Town, the model was calibrated for hydrograph simulation. The impact of urban land covers on storm runoff was evaluated by converting impervious land covers back into pervious covers to facilitate the pre-urbanization condition in a subsequent storm hydrograph simulation. As a result, the before-and-after effect of urban development on storm hydrographs could be assessed. Results using six recorded storm events demonstrated that the peak discharge could be increased as much as 3.77 times after urban development. This magnitude of increase in peak flow is in agreement with the 4.96 times reduction in infiltration capacity observed in the same experiment. (See also W87-06103) (Geiger-PTT)
W87-06114

IMPACTS OF CONTINUED GROWTH ON THE ENVIRONMENTALLY SENSITIVE INLAND BAYS AREA OF DELAWARE AND POLICY RECOMMENDATIONS FOR ENVIRONMENTAL CONTROL,
Greeley-Polhemus Group, Inc., West Chester, PA.
V. D. Polhemus, R. S. Greeley, and G. L. Esposito.
IN: Options for Reaching Water Quality Goals, Proceedings of the Twentieth Annual Conference of the American Water Resources Association Symposium, Washington, DC., August 15, 1984. 1985. p 57-67, 6 fig, 3 tab, 4 ref.

Descriptors: *Management planning, *Inland Bays, *Delaware, *Water pollution effects, *Environmental effects, Public policy, Economic aspects, Environmental protection.

The Inland Bays of southern Delaware is an environmentally attractive and rapidly growing area convenient to major population centers, with low taxes and affordable land values. Without environemntal controls, however, the fragile environment and the environmentally dependent economy will deteriorate. In 1983, a potentially successful institutional approach was initiated to gain broad public acceptance and support for long-range environmental protection in the Inland Bays area. The approach involved two major efforts that placed the environmental issues in perspective and established a process for protecting the Bays: (1) research identified the significance of future environmental deterioration, the timing of environmental impacts to the Bays and the potential economic

losses to property values of uncontrolled growth; and (2) a Task Force of supportive and adversarial interests was established by the State Governor to evaluate the situation and make recommendation. The Task Force produced and unanimously approved 59 recommendations for the management and protection of the area. (See also W87-06270) (Author's abstract)
W87-06275

WATER QUALITY AND THE NEW FARM POLICY INITIATIVES,
Economic Research Service, Washington, DC.
C. W. Ogg, and H. B. Pionke.
Journal of Soil and Water Conservation JWSCA3, Vol. 41, No. 2, p 85-88, March-April 1986. 16 ref.

Descriptors: *Agriculture, *Soil erosion, *Farm management, *Water quality, *Water policy, Sediments, Phosphorus, Lakes, Streams, Siltation.

The effects on water quality of various different farm policies that deny price supports to farmers who work erodible soils are analyzed. Major sources of eroded material, rates of sediment delivery, and sources of phosphorus are reviewed. The response of streams, lakes, and reservoirs to changes in sediment or P inputs can vary greatly because of the chemical, hydrological, and limnological characteristics of an aquatic system. In the Corn Belt and other intensively farmed areas, erosion damage to streams, ponds, and reservoirs can be due largely to siltation or sediment concentrations, for example, turbidity and the addition of algae-available P. A national policy focus on controlling soil loss on the most erodible cropland is thus likely to be effective in protecting streams and lakes. In more marginal farming areas the protection of highly erodible cropland potentially offers cleaner lakes and streams. New policy initiatives for treating highly erodible land could effectively reduce algae-available P losses from agricultural land. (Rochester-PTT)
W87-06399

AQUATIC COMMUNITY RESPONSE TO TECHNIQUES UTILIZED TO RECLAIM EASTERN U.S. COAL SURFACE MINE - IMPACTED STREAMS,
Tennessee Valley Authority, Knoxville.
For primary bibliographic entry see Field 5C.
W87-06442

TROPICAL DEFORESTATION AND EVAPOTRANSPIRATION,
Georgia Univ., Athens. Inst. of Ecology.
For primary bibliographic entry see Field 2D.
W87-06457

EFFECT OF CHANGE IN LANDUSE ON DESIGN FLOODS OF RURAL CATCHMENTS OF SEMI-ARID NORTH-EAST BRAZIL,
Universidade Federal da Paraiba, Joao Pessoa (Brazil).
S. V. K. Sarma.
IN: Symposium on Tropical Hydrology and 2nd Caribbean Islands Water Resources Congress, Proceedings of the International Symposium, May 5-8, 1985, San Juan, Puerto Rico. p 101-103, 1 fig, 1 tab, 5 ref.

Descriptors: *Land use, *Floods, *Rural areas, *Catchment areas, *Semiarid climates, *Brazil, Model studies, Flood forecasting, Mathematical models.

In an attempt to extend the flood estimation model developed on the lines on the U.K. Transport and Roads Research Laboratory, for the two rural catchments of Gangorra and Jatoba of semi-arid Paraiba in north-east Brazil, the effect of change in landuse on the magnitude of the 10-yr floods was investigated. The model utilizes mainly the basin characteristics for the estimation of design floods. The one factor which influences the Contributing Area Coefficient is the Landuse factor. For different values of the Landuse Factor in Sume valley, the design floods for 10-yr recurrence intervals were obtained. While the 10-yr floods in the two basins were 37.76 and 14.56 cu m/s respectively, for the case of ephemeral streams in alluvial valleys, the corresponding values for cases of dense vegetative cover and intensive cultivation were much higher, implying the need for provision of better surface drainage systems in the valley. A regional flood frequency curve is needed, which would serve as a useful tool for easily obtaining the design floods for various recurrence intervals. (See also W87-06455) (Author's abstract)
W87-06476

PREVENTION OF FORMATION OF ACID DRAINAGE FROM HIGH-SULFUR COAL REFUSE BY INHIBITION OF IRON- AND SULFUR-OXIDIZING MICROORGANISMS. I. PRELIMINARY EXPERIMENTS IN CONTROLLED SHAKEN FLASKS,
Ohio State Univ., Columbus. Dept. of Microbiology.
For primary bibliographic entry see Field 5G.
W87-06546

PREVENTION OF FORMATION OF ACID DRAINAGE FROM HIGH-SULFUR COAL REFUSE BY INHIBITION OF IRON- AND SULFUR-OXIDIZING MICROORGANISMS. II. INHIBITION IN 'RUN OF MINE' REFUSE UNDER SIMULATED FIELD CONDITIONS,
Ohio State Univ., Columbus. Dept. of Microbiology.
For primary bibliographic entry see Field 5G.
W87-06547

URBAN USE OF PEAT SOILS,
For primary bibliographic entry see Field 4A.
W87-06631

4D. Watershed Protection

GREAT RIVER RESOURCE MANAGEMENT STUDY: EROSION AND SEDIMENT INVENTORY.
Soil Conservation Service, Columbia, MO.
For primary bibliographic entry see Field 2J.
W87-06432

5. WATER QUALITY MANAGEMENT AND PROTECTION

STUDIES ON FOUR STREAMS ENTERING TOLO HARBOUR, HONG KONG IN RELATION TO THEIR IMPACT ON MARINE WATER QUALITY,
Hong Kong Univ. Dept. of Botany.
For primary bibliographic entry see Field 5B.
W87-06558

5A. Identification Of Pollutants

LEGIONELLA PNEUMOPHILA IN A METROPOLITAN WATER DISTRIBUTION SYSTEM,
Ohio State Univ., Columbus. Dept. of Microbiology.
L. Voss, K. S. Button, and O. H. Tuovinen.
Environmental Technology Letters ETLEDB, Vol. 6, No. 10, p 429-438, October 1985. 5 tab, 22 ref.

Descriptors: *Pollutant identification, *Pathogenic bacteria, *Water distribution, *Ohio, *Legionella pneumophila, *Bacterial analysis, Chlorine, Stagnant water, Pipelines, Sample preparation, Cultures, Isolation.

Legionella pneumophila (serogroup 1) was detected by cultural methods in cold water samples from consumers' lines in the Columbus, Ohio, distribution system. The occurrence was associated with stagnant or low chlorine and low hydraulic flow conditions in the system, such as infrequently-used cold water hose bibs in indoor areas. In one instance, L. pneumophila was isolated from a sample associated with a high chlorine residual site. L. pneumophila also was isolated from hot water samples. Serogroup 3 and 6 cross-reactive L. pneumophila was found in one of the two surface water reservoirs serving the municipal water treatment plants. Low density samples were negative for L. pneumophila upon direct plating, but were positive if the samples were concentrated (100- to 1000-fold) before enumeration. Concentration methods gave low quantitative recoveries but they were useful for qualitative demonstration of L. pneumophila contamination. These results indicate that various concentration methods result in significant underestimation of Legionella densities. (Author's abstract)
W87-05923

COMPOSITION OF WASH-WATERS FROM DRIED VINE-FRUIT,
Commonwealth Scientific and Industrial Research Organization, North Ryde (Australia). Div. of Food Research.
P. G. Gwatkin, and A. G. Lane.
Environmental Technology Letters ETLEDB, Vol. 7, No. 1, p 13-16, January 1986. 2 tab, 8 ref.

Descriptors: *Pollutant identification, *wastewater treatment, *Fruit crops, *Washing, *Anaerobic treatment, Wastewater facilities, Australia, Currants, Sultanas, Raisins, Glucose, Fructose, Lipids, Dissolved minerals.

Analysis of wash-waters produced during processing of Australian dried sultanas, currants, and raisins showed the major components were glucose and fructose (0.6-0.7 deg Brix), lipids (approximately 0.16% w/w), dissolved minerals (0.6% w/w), and suspended matter (0.2% w/w). The anaerobic sludge blanket appears to offer advantages over presently available treatment processes for treating these wastes. (Author's abstract)
W87-05937

MUSTY ODOR FROM BLUE-GREEN ALGA, PHORMIDIUM TENUE IN LAKE KASUMIGAURA,
National Inst. for Environmental Studies, Tsukuba (Japan).
For primary bibliographic entry see Field 5B.
W87-05941

HEAVY METAL, BACTERIAL AND VIRAL CONTAMINATION OF SEWAGE SLUDGES IN OXIDATION PONDS (CHARGES EN METAUX LOURDS, BACTERIES ET VIRUS, PRESENTES DANS LES BOUES D'UNE STATION D'EPURATION PAR LAGUNAGE NATUREL),
Ecole Nationale de la Sante Publique, Rennes (France). Lab. de Genie Sanitaire.
For primary bibliographic entry see Field 5D.
W87-05944

MEASUREMENT OF COPPER IN INDIVIDUAL AQUATIC INSECT LARVAE,
Plymouth Polytechnic (England). Faculty of Science.
S. T. Darlington, A. M. Gower, and L. Ebdon.
Environmental Technology Letters ETLEDB, Vol. 7, No. 3, p 141-146, March 1986. 1 fig, 5 tab, 12 ref.

Descriptors: *Pollutant identification, *Path of Pollutants, *Bioaccumulation, *Atomic absorption spectroscopy, *Copper, *Aquatic insects, *Tissue analysis, England, Larvae, Pupae, Stream pollution, Streams.

Using graphite furnace atomic absorption spectroscopy, a program was developed to measure Cu concentration in single specimens of the larvae, and also pupae and adults, of the caddis fly Plectrocnemia conspersa. Each larval instar from Cu-contaminated stream (Darley Brook, Cornwall, England; Cu 0.73-0.93 mg/l, hardness 6.13-10.68 mg/l, and pH 5.6) contained significantly more Cu than the same instar from a control stream (Cu <0.04 mg/l, hardness 8.21-14.19 mg/l, and pH 6.4). Highest concentrations (> 1100 microgram/

g) were recorded in young larvae, and there was an exponential decrease in larval Cu concentration with increasing body weight for both populations. Significantly lower concentrations were found in pupae and adults. (Author's abstract)
W87-05946

SEMI-MICRO DETERMINATION OF C.O.D. ON FISH FILLETING WASTEWATER,
Centro de Investigaciones de Tecnologia Pesquera, Mar del Plata (Argentina).
J. F. Gonzalez.
Environmental Technology Letters ETLEDB, Vol. 7, No. 5, p 269-272, May 1986. 1 fig, 4 tab, 6 ref.

Descriptors: *Chemical oxygen demand, *Wastewater analysis, *Fish handling facilities, Statistics, Performance evaluation.

A semi-micro chemical oxygen demand (COD) procedure was studied using a 2 to the 4th power factorial design in which the influence of temperature, digestion time, dichromate concentration, and catalyst concentration were evaluated. It was concluded that temperature is the most significant variable, followed by dichromate concentration, digestion time, and catalyst concentration in decreasing order of importance. Experimental conditions are recommended that produce results that are not statistically different from those obtained with the standard reflux method. (Author's abstract)
W87-05950

CHLORINATION OF FATTY ACIDS DURING WATER TREATMENT DISINFECTION: REACTIVITY AND PRODUCT IDENTIFICATION,
Water Research Centre, Marlow (England).
For primary bibliographic entry see Field 5F.
W87-05957

CHEMICAL COMPOSITION OF HIGHWAY DRAINAGE WATERS: IV. ALKYLLEAD COMPOUNDS IN RUNOFF WATERS,
Essex Univ., Colchester (England). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W87-05973

DETERMINATION OF TIN IN THE NG/G RANGE BY DIFFERENTIAL PULSE POLAROGRAPHY,
Institut fuer Spektrochemie und Angewandte Spektroskopie, Dortmund (Germany, F.R.).
G. Weber.
Analytica Chimica Acta ACACAM, Vol. 186, p 49-56, August 1986. 4 fig, 2 tab, 13 ref.

Descriptors: *Tin, *Pollutant identification, *Polarographic analysis, *Water analysis, Chemical analysis.

The tin contents of environmental and biological samples cover a wide range, from microgram/gram quantities in canned foods to nanogram/gram and picogram/gram quantities in water and urine. A sensitive determination method of tin by differential pulse polarography is described. Addition of tropolone to acetate supporting electrolyte at about pH 4.7 provides a 30-fold signal enhancement, giving a sensitivity comparable to that obtained in anodic stripping voltammetry, but without the need for enrichment by pre-electrolysis. The response is linear over more than three orders of magnitude (1 nanogram/ml to 5 micrograms/ml Sn), allowing measurements within a wide range without changes in sample preparation or measuring conditions. Large amounts of Ti, W, Cr or Mo interfere, but can be removed completely by preseparation of tin based on extraction with tropolone/toluene and back extraction into the supporting electrolyte. Results for tin in water and fruit juice are consistent with those obtained by other techniques. (Author's abstract)
W87-05981

ELECTRON PARAMAGNETIC RESONANCE SPECTROSCOPY IN STUDIES OF THE CHEMICAL STATES OF MANGANESE IN PARTICULATE SUBSTANCES IN RIVER WATERS AND OF THE REDUCTION OF MANGANESE BY TANNERY EFFLUENTS,
Hyogo Prefecture Environmental Science Inst., Kobe (Japan).
T. Yoshimura, T. Ozaki, and T. Okuno.
Analytica Chimica Acta ACACAM, Vol. 186, p 115-122, August 1986. 3 fig, 2 tab, 26 ref.

Descriptors: *Manganese, *Water analysis, *Chemical analysis, *Tannery wastes, *Electron paramagnetic resonance spectroscopy, Water pollution.

Manganese is indispensable to all organisms and both manganese deficiency and excessive intake are deleterious to all organisms. A knowledge of the transfer and chemical states of manganese in river water is essential to an understanding of the manganese cycle in soil-water-plant-animal relationships. Manganese within the pH range of natural waters is present as manganese (II) in solution and manganese (III) and (IV) is suspended solids. The chemical states of manganese (II) species in particulate substances in river water, with and without the influence of tannery effluents, were investigated by the use of electron paramagnetic resonance (EPR) spectroscopy. In the EPR spectra of the particulate substances in river water, the six-line signal characteristic of Mn(II) was distinctly observed. The relative intensity of the Mn(II) signal was found to be higher in the lower reaches of the river, and especially below tannery effluent inflows, suggesting that manganese in river water is reduced by natural and artificially added organic compounds. It is shown that the reduction of manganese in river sediments and manganese dioxide by tannery effluents can afford an insoluable Mn(II) species at pH 11 and a soluble Mn(II) species at pH 7. (Authors' abstract)
W87-05982

FLOW-INJECTION CONFIGURATIONS FOR CHROMIUM SPECIATION WITH A SINGLE SPECTROPHOTOMETRIC DETECTOR,
Cordoba Univ. (Spain). Dept. of Analytical Chemistry.
For primary bibliographic entry see Field 2K.
W87-05983

DETERMINATION OF BISMUTH IN RIVER SEDIMENT BY ELECTROTHERMAL ATOMIC ABSORPTION SPECTROMETRY WITH LOW TEMPERATURE ATOMIZATION IN ARGON/HYDROGEN,
N. Zhe-Ming, L. Xiao-Chun, and H. Heng-Bin.
Analytica Chimica Acta ACACAM, Vol. 186, p 147-153, August 1986. 3 fig, 3 tab, 17 ref.

Descriptors: *Bismuth, *Pollutant identification, *Water analysis, *Chemical analysis, *Sediments, Atomic absorption, Spectrometry.

Electrothermal atomic absorption spectrometry appears to provide a convenient, rapid and sensitive method for the determination of bismuth in metals, alloys, and environmental and biological samples. However, the volatility of bismuth often caused the metal to be lost from the graphite furnace if the charring temperature exceeded 500 C. A method is described for the direct determination of bismuth (1-5 micrograms/g) in river sediments by graphite furnace a.a.s. in 90% argon/10% hydrogen with low-temperature atomization. The presence of 10% hydrogen in the argon sheath gas promotes atomization; the bismuth absorption reaches a maximum at 850-950 C, which allows better discrimination of the atomic signal from the background absorption. The use of trisodium phosphate as the matrix modifier further decreases the interference effects from the matrix components and increases the sensitivity. The results, obtained from direct calibration with aqueous standards, are in good agreement with certified values. (Authors' abstract)
W87-05984

SIMULTANEOUS DETERMINATION OF TOTAL NITROGEN AND TOTAL PHOSPHORUS IN FRESHWATER SAMPLES USING PERSULFATE DIGESTION,
National Inst. for Environmental Studies, Tsukuba (Japan).
For primary bibliographic entry see Field 2K.
W87-05990

OCCURRENCE AND SPECIATION OF ORGANOMETALLIC COMPOUNDS IN FRESHWATER SYSTEMS,
Canada Centre for Inland Waters, Burlington (Ontario).
Y. K. Chau.
The Science of the Total Environment STENDL, Vol. 49, p 305-323, 1986. 2 fig, 3 tab, 101 ref, append.

Descriptors: *Organometal compounds, *Reviews, *Speciation, *Pollutant identification, *Chemical analysis, *Water analysis, *Aquatic environment, Environment, Lead, Tin, Separation techniques, Chromatography, Gas chromatography, Water pollution, Water pollution sources, Spectroscopy, Atomic adsorption spectroscopy, Sample preparation.

Organometals and organometalloids have been found in environmental samples as a result of their extensive usage and biotic and abiotic methylation processes. Alkyllead and organotin compounds are the most widely used organometals. Highly sensitive and specific analytical techniques have been developed for speciation analysis organometals; the best methods are combination methods consisting of a separation technique with gas or liquid chromatography coupled to a specific detection system such as atomic spectrometry. Atomic spectrometric detectors used include atomic absorption, atomic emission, and atomic fluorescence spectrometry. Excitation techniques include flame and furnace for atomic absorption and various forms of plasma excitation for atomic emission. The most commonly used element-specific systems for the determination of organometallic compounds in freshwater and estuarine environments are reviewed. (Author's abstract)
W87-06005

TOXIC PEPTIDES FROM FRESHWATER CYANOBACTERIA (BLUE-GREEN ALGAE). I. ISOLATION, PURIFICATION AND CHARACTERIZATION OF PEPTIDES FROM MICROCYSTIS AERUGINOSA AND ANABAENA FLOS-AQUAE,
Chemical Research, Development and Engineering Center, Aberdeen Proving Ground, MD.
T. Krishnamurthy, W. W. Carmichael, and E. W. Sarver.
Toxicon TOXIA6, Vol. 24, No. 9, p 865-873, September 1986. 6 fig, 1 tab, 17 ref.

Descriptors: *Cyanophyta, *Peptides, *Isolation, *Chemical analysis, *Water pollution effects, *Anabaena, *Microcystis, *Sample preparation, *Pollutant identification, Aquatic environment, *Algal toxins, Algae, Environment, Chromatography, Mass spectrometry, Gels, Reagents, Bioassay, Assay, Toxins, Amino acids, Cyanobacteria.

Toxic peptides from two Microcystis aeruginosa and one Anabaena flos-aquae species of freshwater (blue-green algae) were purified by high performance liquid chromatography (HPLC) and examined by amino acid analysis and mass spectrometry. A toxic fraction from a butanol/methanol extract of toxic lyophilized cells was separated by G-25 gel filtration and purified by HPLC using a C-18 semi-preparative column. A toxic peak with the same elution time was detected for each of the three toxic cyanobacteria. The desalted purified toxins (i.p. LD50 in mice = 50 micrograms/kg) caused signs of poisoning identical with published reports of hepatotoxic peptides from Microcystis. On hydrolysis and amino acid analysis, all three toxins showed a similar profile, consisting of equimolar amounts of glutamic acid, alanine, arginine, and leucine. Beta-methyl aspartic acid was identified in all of the toxic peptides. The fast atom bombardment mass spectra of the toxins indicated the molecular weight to be 994 for all the peptides.

The absence of sequence ions in their corresponding fast atom bombardment mass spectra indicated the peptides to be cyclic. (Author's abstract)
W87-06009

LEGIONELLA IN COOLING TOWERS,
Environmental Protection Agency, Burlington, VT. Vermont Field/Special Projects Office.
L. E. Witherell, L. F. Novick, K. M. Stone, R. W. Duncan, and L. A. Orciari.
Journal of Environmental Health JEVHAH, Vol. 49, No. 3, p 134-139, November-December 1986. 4 fig, 41 ref.

Descriptors: Pollutant identification, *Legionella, *Statistical analysis, *Cooling towers, *Public health, *Microbiological studies, *Water pollution sources, Sampling, Bacteria, Pathogenic bacteria, Aerosols, Hydrogen ion concentration, Turbidity, Physical properties, Chemical properties, Water quality.

From April 1981 to April 1982, the Vermont Department of Health undertook a program to inventory, inspect, and sample all wet-type heat rejection units (WTHRUs) in the state for Legionella pneumophila. Of 184 operating WHTRUs, statistical analyses were performed on those 130 which were sampled only once during the study period. Of these, 11 (8.5%) were positive for L. pneumophila. Five of 92 towers (5.4%) using surface water sources for cooling were positive in contrast to 6 positive towers of the 38 units (15.8%) which obtained makeup water from groundwater ($p = 0.054$ by chi square test). Nearly 15% of the 54 units which operated throughout the year were positive, compared to less than 4% of the 76 towers operating seasonally ($p = 0.03$ by chi square test). The mean pH of cooling water in units where L. pneumophila was recovered (8.3) was significantly higher than the mean pH of 7.9 in units testing negative ($p < 0.05$ by t-test). The mean log-transformed turbidity of positive towers (0.03 nephelometric units) was significantly lower than the mean of log turbidity of negative towers, 0.69 ntu ($p < 0.02$ by t-test). (Author's abstract)
W87-06012

OCCURRENCE AND BIOLOGICAL ACTIVITY TESTING OF PARTICULATES IN DRINKING WATER,
McCrone Environmental Services, Inc., Norcross, GA.
For primary bibliographic entry see Field 5F.
W87-06021

SIGNIFICANCE OF THE TAURINE-GLYCINE RATIO AS AN INDICATOR OF STRESS,
Kiel Univ. (Germany, F.R.). Inst. fuer Meereskunde.
N. Scholz.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 1, p 15-21, January 1987. 4 fig, 3 tab, 16 ref. German BMFT Grant MFU 0521-0.

Descriptors: *Water pollution effects, *Amino acids, *Indicators, *Toxicity, *Bioindicators, *Water quality, Stress, Heavy metals, Copper, Cadmium, Nutrition, Mussels, Mollusks, Mytilus, Population exposure.

The applicability of the taurine-glycine ratio as a biochemical stress index was investigated using three groups of blue mussels exposed to 10 micrograms/l cadmium, 20 micrograms/l copper, and starvation, respectively. Heavy metal concentrations were well below lethal levels. It was found that, in each experimental group, the taurine-glycine ratio increased with time. In the case of cadmium, a distinct rise occurred after six days of exposure, the mean value of 11.3 indicating a nearly six-fold increase over normal levels. The effect of copper was temporary; the enhanced level of 7.6 reached after three days declined to control values within the next few days. The ratio in response to starvation rose steadily and remained constantly high at about 8.3. The causes leading to enhanced taurine glycine ratios are discussed and found to be different in each experiment. It is concluded that constant comparisons of the taurine-glycine ratio between unstressed (control) populations and possibly endangered ones could serve as a useful early warning tool prior to extensive diagnostic investigations. (Doria-PTT)
W87-06023

LEVELS OF NINE POTENTIALLY TOXIC ELEMENTS IN IDAHO FISH MANURES,
Idaho Univ., Moscow. Washington Animal Disease Diagnostic Lab.
R. I. Krieger, D. Marcy, J. H. Smith, and K. Tomson.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 1, p 63-66, January 1987. 2 tab, 6 ref.

Descriptors: *Pollutant identification, *Fertilizers, *Fish manure, *Fish, *Chemical analysis, *Idaho, *Water pollution sources, *Soil amendments, *Waste disposal, Trout, Arsenic, Cadmium, Cobalt, Chromium, Copper, Mercury, Nickel, Lead, Zinc, *Heavy metals, Nitrogen, Phosphorus, Potassium, Nutrients, Fish hatcheries, Toxicity, Agriculture.

The concentration of heavy metals, arsenic, cobalt, and various nutrients were determined in fish manures being evaluated as fertilizers for Idaho croplands. Large wet samples of manure were obtained from trout hatcheries, representing a worst-case situation, since manure to be used for fertilizer would be pretreated. Levels of arsenic, cadmium, cobalt, chromium, copper, mercury, nickel, lead, and zinc were lower than levels reported for cow manure and municipal sewage sludges. Moreover, owing to their relatively high nitrogen content, fish wastes would probably be used at lower application rates than sludges to achieve equivalent nitrogen per acre rates, further reducing the likelihood of biologically significant soil or crop contamination. It is concluded that land application of fish manure as a fertilizer is a potentially beneficial alternative where discharge of fish manures into water is prohibited. (Doria-PTT)
W87-06031

DETERMINATION BY COMBUSTION OF THE TOTAL ORGANOCHLORINE CONTENT OF TISSUES, SOIL, WATER, WASTE STREAMS, AND OIL SLUDGES,
Sydney Univ. (Australia). Dept. of Histology and Embryology.
M. Morton, and J. K. Pollak.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 1, p 109-116, January 1987. 1 fig, 3 tab, 13 ref.

Descriptors: *Chlorinated hydrocarbons, *Analytical methods, *Chemical analysis, *Water analysis, *Tissue analysis, *Pollutant identification, *Chlorides, *Sample preparation, *Soil analysis, Waste characteristics, Oil characterization, Sludge, Hydrocarbons, Degradation, Colorimetry, Reagents, Laboratory equipment, Chromatography, Performance evaluation.

A method is described that is suitable for measuring gram quantities of total lipid-soluble organochlorine, chlorine in tissues, tissue fluids, water, soil, liquid industrial wastes, and oil sludges. The method is simple and consists of three steps: (1) a small-volume extraction procedure that extracts organic compounds containing chlorine, but excludes organic chlorides; (2) the degradation of organically bound chlorine to inorganic chlorides; and (3) a colorimetric assay of the resulting chlorides. Organochlorine values found in human adipose tissue by this method were significantly higher than the sum of individual organochlorines determined in human adipose tissue in published investigations, suggesting that this procedure included organochlorine compounds not detected by the chromatographic analyses of specific organochlorine compounds. The method is simple, reproducible, involves small volumes, and is speedily performed. If total organochlorine is found to be high, portions of the extract may be analyzed for specific compounds by GLC-mass spectrometry; samples with low organochlorine content require no further analysis, minimizing the need for more time-consuming and costly instrumentation. (Doria-PTT)
W87-06035

USE OF MARINE BENTHIC 'KEY' SPECIES ON ECOTOXICOLOGICAL TESTING: AMPHIURA FILIFORMIS (O.F. MULLER) (ECHINODERMATA: OPHIUROIDEA),
University Coll., Galway (Ireland). Dept. of Zoology.
T. Bowmer, R. G. V. Boelens, B. F. Keegan, and J. O'Neill.
Aquatic Toxicology AQTODG, Vol. 8, No. 2, p 93-109, June 1986. 3 fig, 3 tab, 28 ref. Commission of the European Communities Contract ENV 695 EIR (H).

Descriptors: *Water pollution effects, *Amphiura, *Sensitivity analysis, *Bioindicators, *Toxicity, Pollutants, Marine animals, Echinoderms, Mortality, Ions, Benthos, Benthic fauna, Aquatic life.

Methodological aspects of toxicological testing with Amphiura filiformis (O.F. Muller), a presumed marine 'key' species, were reported. This infaunal ophiuroid echinoderm can be readily maintained in the laboratory, and demonstrates graded responses for surfacing (emerging from its burrow) and mortality. The sensitivity of this species to Cu(2+), pentachlorophenol, un-ionized ammonia, and dieldrin are reported. A. filiformis is moderately sensitive to copper, pentachlorophenol and un-ionized ammonia, although it is less sensitive to dieldrin than many other marine species. The 96-h LC 50 and EC 50 values obtained with the four toxicants are discussed in relation to comparative tests on th commonly used species Crangon crangon (L.) and Artemia salina (L.), as well as published data on other marine test species. The significance and potential use of 'key' species in ecotoxicological testing are also considered. (Author's abstract)
W87-06038

PROPOSAL FOR THE REDUCTION OF ANIMAL NUMBERS REQUIRED FOR THE ACUTE TOXICITY TO FISH TEST (LC 50 DETERMINATION),
Huntingdon Research Centre PLC (England).
M. T. Douglas, D. O. Chanter, I. B. Pell, and G. M. Burney.
Aquatic Toxicology AQTODG, Vol. 8, No. 4, p 243-249, September 1986. 1 fig, 3 tab, 12 ref. Department of the Environment (England) Contract PECD 7/8/030-11/83.

Descriptors: *Biassay, *Bioindicators, *Experimental design, *Experimental data, *Acute toxicity test, *Water pollution effects, *Toxicity, *Trout, *Test design, Pollutants, Precision, Fish, Chemical wastes, Hazards, Organic compounds.

Juvenile rainbow trout (Salmo gairdneri) were exposed to 10 common industrial and agricultural chemicals in a series of acute toxicity tests to provide data for the evaluation of the test design currently employed in hazard assessment for novel chemicals in the aquatic environment. Analysis of these data revealed that the widely employed design of 10 fish at each of 5 concentrations covering one order of magnitude could be modified to one of 7 fish at each of 4 concentrations with minimal reduction in the precision of the result (i.e., the LC 50 value). The adoption of this modification to test design, however, would result in a reduction of approximately 40% of the number of experimental animals used in bioassay programs. (Author's abstract)
W87-06046

ORGANIC COPPER AND CHROMIUM COMPLEXES IN THE INTERSTITIAL WATERS OF NARRAGANSETT BAY SEDIMENTS,
Rhode Island Univ., Narragansett. Graduate School of Oceanography.
G. S. Douglas, G. L. Mills, and J. G. Quinn.
Marine Chemistry MRCHBD, Vol. 19, No. 2, p 161-174, May 1986. 4 fig, 46 ref. NSF Grant OCE-8200150.

Descriptors: *Path of pollutants, *Pollutant identification, *Pollution load, *Sediments, *Copper, *Chromium, *Organic compounds, *Narragansett Bay, *Interstitial water, Pollutants, Dissolved solids, Chromatography, Spectroscopy, Atomic absorption spectroscopy, Chemical analysis, Organic carbon, Sulfides, Cores, Geochemistry.

Dissolved organic copper and chromium complexes were measured in both overlying and interstitial waters of Narragansett Bay and mesocosm sediments using C18 reverse-phase liquid chromatography and atomic absorption spectroscopy. In the interstitial and overlying waters, the isolation procedure recovered 22-67% of the total dissolved copper, 23-55% of the total dissolved chromium and 14-40% of the dissolved organic carbon. The distribution of both total and organic copper decreased with depth in the cores and exhibited a subsurface maximum near the zero Eh level (z = 2-4 cm). Below that depth, both forms of copper continued to decrease until an apparent equilibrium with sulfide minerals was established (7-8 cm). Dissolved chromium exhibited a different geochemistry, with both total and organic chromium increasing in concentration with depth in the cores, possibly due to remobilization from some mineral phase such as chromic hydroxide or chromite. (Author's abstract)
W87-06056

COMPARISON OF TWO METHODS FOR DETERMINING COPPER PARTITIONING IN OXIDIZED SEDIMENTS,
Geological Survey, Menlo Park, CA.
S. N. Luoma.
Marine Chemistry MRCHBD, Vol. 20, No. 1, p 45-59, October 1986. 4 fig, 1 tab, 29 ref, 2 append.

Descriptors: *Sample preparation, *Sediments, *Copper, *Comparison studies, *Model studies, *Data interpretation, *Estuaries, Oxidation, Organic matter, Ammonium hydroxide, Mathematical equations, Mathematical models, Mathematical studies.

Model estimations of the proportion of Cu in oxidized sediments associated with extractable organic materials show some agreement with the proportion of Cu extracted from those sediments with ammonium hydroxide. Data were from 17 estuaries of widely differing sediment chemistry. The modelling and extraction methods agreed best where concentrations of organic materials were either in very high concentrations, relative to other sediment components, or in very low concentrations. In the range of component concentrations where the model predicted Cu should be distributed among a variety of components, agreement between the methods was poor. Both approaches indicated that Cu was predominantly partitioned to organic materials in some sediments, and predominantly partitioned to other components (most probably iron oxides and manganese oxides) in other sediments, and that these differences were related to the relative abundances of the specific components in the sediment. Although the results of the two methods of estimating Cu partitioning to organics correlated significantly among 24 stations from the 17 estuaries, the variability in the relationship suggested that refinement of parameter values and verification of some important assumptions were essential to the further development of a reasonable model. (Author's abstract)
W87-06061

EVIDENCE FOR EXPOSURE OF FISH TO OIL SPILLED INTO THE COLUMBIA RIVER,
National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.
M. M. Krahn, L. J. Kittle, and W. D. MacLeod.
Marine Environmental Research MERSDW, Vol. 20, No. 4, p 291-298, 1986. 1 fig, 1 tab, 11 ref.

Descriptors: *Water pollution effects, *Oil spills, *Oil pollution, *Sturgeon, *Fluorescence, *Rivers, *Field tests, *Columbia River, Pollutants, Oil, Fish, Measuring instruments, Chromatography, Estimating, Population exposure, Aromatic compounds, Metabolites, Hydrocarbons, Statistical analysis, Statistics.

On March 19, 1984, more than 170,000 gallons of oil were spilled into the Columbia River. A nonradiometric analytical method using high-performance liquid chromatography (HPLC) with fluorescence detection for estimating the exposure of fish to aromatic compounds by measuring the concentrations of metabolites of these contaminants in fish bile was recently developed. The oil spill provided an opportunity to field test the new methods in assessing the exposure of fish to petroleum aromatic compounds from the spilled oil. The findings indicated that, within five days after the spill, mean concentrations of metabolites of aromatic compounds in the bile of white sturgeon (Acipenser transmontanus) captured 57 miles downstream from the spill were significantly higher than those of sturgeon caught upriver. This evaluation showed the HPLC/fluorescence method to be a simple, rapid means of determining exposure of fish to aromatic hydrocarbons since the bile collected from the fish could be processed easily and quickly by the direct injection technique. The quantitation of the fluorescence response in terms of the reference standard permitted statistical comparisons to be made between exposures of fish from contaminated and reference sites. This technique was less expensive and less time-consuming than the previously used GC/MS methods. (Wood-PTT)
W87-06068

MARINE POLLUTION MONITORING CONCERNS: SUMMARY REPORT FOR THE STATE OF HAWAII,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 7A.
W87-06119

POLLUTANTS AND THEIR ECOTOXICOLOGICAL SIGNIFICANCE.
For primary bibliographic entry see Field 5C.
W87-06187

BASIC ECOLOGICAL PARAMETERS, MONITORING AND BIOLOGICAL MONITORS IN THE AQUATIC ENVIRONMENT,
Barcelona Univ. (Spain). Facultat de Biologia.
For primary bibliographic entry see Field 5B.
W87-06188

ASSESSING POLLUTION IN THE MEDITERRANEAN SEA,
International Lab. of Marine Radioactivity, Monaco-Ville (Monaco).
For primary bibliographic entry see Field 5C.
W87-06195

BIOASSESSMENT METHODOLOGIES FOR THE REGULATORY TESTING OF FRESHWATER DREDGED MATERIAL, PROCEEDINGS OF A WORKSHOP.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
Army Corps of Engineers. Miscellaneous Paper EL-86-6, June 1986. Final Report. Compiled by Thomas M. Dillon, and Alfreda B. Gibson. 373 p, 4 fig, 8 ref, 5 append.

Descriptors: *Water quality control, *Sediments, *Dredging, Biological testing, Waste disposal, Ocean dumping, Toxicity, Bioaccumulation, Water pollution control, Conferences.

A workshop was conducted by the Army Corps of Engineers in Milwaukee, Wisconsin to identify appropriate bioassessment testing methodologies for the regulatory testing of freshwater sediments scheduled for open-water disposal. To identify potentially useful methodologies, participants from private industry, the Federal government, and institutions of higher learning were invited to attend and participate in the workshop. At the workshop, topics of discussion included hazard assessment, bulk sediment chemistry, acute toxicity tests, chronic toxicity tests, other bioassessment techniques, and assessment of bioaccumulation potential. These technical issues were discussed and debated. (Lantz-PTT)
W87-06200

MICROORGANISMS AS GROUNDWATER TRACERS,
Arizona Univ., Tucson. Dept. of Microbiology and Immunology.
C. P. Gerba.
IN: Groundwater Pollution Microbiology, John Wiley and Sons, New York, New York, 1984. p 225-233, 2 tab, 39 ref.

Descriptors: *Path of pollutants, *Groundwater movement, *Bioindicators, *Environmental tracers, Tracers, Bacteria, Viruses, Escherichia coli.

The movement of bacteria and viruses into groundwater is influenced by many environmental factors that are difficult to define completely, making the ability to trace microbial movement in groundwater essential for recognizing the potential for transmission of disease-causing microorganisms. Therefore, it is desirable to use tracer techniques to monitor the movement of microorganisms with percolating water through soil systems and groundwater when assessing new sites for land application of wastewater, septic-tank drain fields, and investigating sources of waterborne disease outbreaks. Most groundwater tracers used for hydrological and geological studies are chemicals, using fluorescein dyes or halogen salts. The criteria for selecting a suitable tracer organism for groundwater contamination are survival time and retention in soil water systems. Microbial tracers have the advantage of not being mutagenic, not having potential toxic effects, and having a finite lifetime. Because of their size, the movement of yeast (3-7 micrometers) and bacteria (1-2 micrometers) is more limited in groundwater than viruses (0.02-0.4 micrometers). Large reductions of bacteria can occur after percolation of sewage through a meter or less of sandy soil. Virus removal by soil is believed to be due largely to adsorption. In general, viruses would be expected to travel longer distances in the subsurface if ionic concentrations are low and the pH of the groundwater is above neutral. Virus adsorption is also highly type -/ and strain-dependent and some viruses are poorly removed by soils. Recent laboratoy and field tests have found E. coli phage f2 to have the lowest removal of any animal or bacterial virus studied. Results are usually obtained within 24-48 hrs. Stocks of E. coli phage f2 and MS-2 can be produced to yield 10 to the 11th-10 to the 12th phage/ml in crude cell lysates. One to two ml samples can be conveniently assayed using standard assay techniques. For greater sensitivity, methods are available for the concentration of phages from large volumes of water. With the use of these techniques, it is possible to detect as little as 2-3 phages in a 20-liter volume of water. Phage assay requries 12-24 hr, which may be a drawback in some applications. (See also W87-06201) (Lantz-PTT)
W87-06211

BIOCHEMICAL INDICATORS OF GROUNDWATER POLLUTION,
Oklahoma State Univ., Stillwater. Dept. of Biochemistry.
F. R. Leach.
IN: Groundwater Pollution Microbiology, John Wiley and Sons, New York, New York, 1984. p 303-351, 4 fig, 10 tab, 198 ref. EPA Grant R804613.

Descriptors: *Bioindicators, *Monitoring, *Groundwater pollution, *Biochemical tests, *Fate of pollutants, Epifluorescence, Immunochemistry, Metabolism, Enzymes, Respiration, Radioisotopes, Literature review.

Biochemical methods for determining the extent of groundwater pollution are discussed here, from a broad-based literature review. Some of the techniques are: (1) plate count; (2) epifluorescence; (3) immunochemical staining; (4) metabolic staining; (5) metabolic fumigation; (6) respiration; (7) radioisotope incorporation; (8) bioluminescence; (9) enzymatic activity; (10) uronic acid composition; (11) ATP composition; and (12) fecal sterols. (See also W87-06201) (Lantz-PTT)

W87-06214

CHARACTERIZATION OF SPILLED OIL SAMPLES: PURPOSE, SAMPLING, ANALYSIS AND INTERPRETATION.
Institute of Petroleum, London (England). Marine Environment Committee.
John Wiley and Sons, Chichester, England. 1986. 95 p. Edited by J. A. Butt, D. F. Duckworth, and S. G. Perry.

Descriptors: *Pollutant identification, *Sampling, Oil characterization, Oil spills, Chemical analysis, Oil pollution, High performance liquid chromatography, Nuclear magnetic resonance, Mass spectrometry, Computers.

The abundance of analytical techniques which can be applied to the characterization of oils is most apparent. No single analytical protocol can, however, withstand the scientific and economic constraints of a universal fingerprinting technique. In practice, methods used will depend on the facilities and expertise available. The most widely applied analytical schemes are likely to continue in popularity in the foreseeable future owing to the general availability of suitable analytical instrumentation. It is unlikely that any of the techniques discussed in this section will revolutionize oil fingerprinting, although many show promise to aid the analytical chemist. HPLC will probably have the largest impact in the near future, particularly with ragard to rapid and reproducible preparative fractionation of characteristic and recalcitrant compound classes. 13-C NMR and 'soft' ionization mass spectrometry are likely to gain further acceptance, particularly as complementary/confirmatory techniques. With the rapid expansion in use of microprocessors and computers, pattern recognition techniques will undoubtedly improve and become more widely available for interpretation of the complex results usually associated with oil fingerprinting. (Lantz-PTT)
W87-06237

SITE-SPECIFIC WATER QUALITY CRITERIA FROM IN-STREAM MONITORING DATA,
American Electric Power Service Corp., Columbus, OH. Environmental Engineering Div.
J. H. Van Hassel, and A. E. Gaulke.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 5, p 417-426, May 1986. 4 fig, 2 tab, 25 ref.

Descriptors: *Monitoring, *Water pollution effects, *Mayflies, *Bioassay, *Water quality standards, *Copper, Effluents, Downstream, Riffles, Streams, Statistics, Mathematical equations.

The determination of site-specific water quality criteria generally involves recalculation of national criteria using laboratory-derived toxicity data or the conducting of bioassays using site water. Because of uncertainty of predictions of in-stream biological responses to contamination, an alternative procedure using stream benthic surveys and water quality data was applied at the Appalachian Power Company Clinch River Plant on the Clinch River in southwestern Virginia. Benthic surveys of riffle transects at four stations located upstream and downstream of the plant showed no significant differences among sites, except just below the effluent discharge site. During low-flow periods there were significant decreases at this site in the percentage of mayflies in the organisms collected. Effluent and ambient chemical data were examined statistically with respect to the biological data. Increased copper concentrations were significantly associated with decreases, from reference levels, in percent mayflies at the impacted area. A linear equation was derived relating decreased percent mayflies to increased copper concentrations. A no effect level based on the least detectable difference in percent mayflies produced a total recoverable copper criterion of 34.2 microgram/L. Criteria or impact estimates derived from in-stream data possess many advantages; they are a valuable tool for reducing uncertainty through integrated field-laboratory assessments. (Author's abstract)
W87-06315

CHARACTERIZATION OF CHEMICAL WASTE SITE CONTAMINATION AND DETERMINATION OF ITS EXTENT USING BIOASSAYS,
Battelle Pacific Northwest Labs., Richland, WA.
J. M. Thomas, J. R. Skalski, J. F. Cline, M. C. McShane, and J. C. Simpson.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 5, p 487-501, May 1986. fig, tab, ref. EPA Agreement TD 1598; DOE Contract DE-AC06-76RL01830.

Descriptors: *Pollutant identification, *Toxicity, *Water pollution effects, *Waste disposal, *Waste dumps, *Bioassay, *Kriging, Algae, Sensitivity, Phytoassay, Rocky Mountain Arsenal, Organic compounds, Pesticides, Cleanup.

Bioassays were used in a three-phase research project to (a) assess the comparative sensitivity of test organisms to known classes of chemicals, (b) determine if the chemical components in field soil and water samples of unknown chemical composition could be inferred from laboratory studies using pure chemicals and (c) investigate kriging (a relatively new statistical 'mapping' technique) and bioassays as methods to define the areal extent of chemical contamination. The algal assay generally was most sensitive to samples of pure chemicals, soil elutriates and water from eight sites with known chemical contamination. Bioassays of nine samples of unknown chemical composition from the Rocky Mountain Arsenal site showed that a lettuce seed soil contact phytoassay was most sensitive. Preliminary evidence suggests that bioassays might be a useful tool in broadly identifying classes of toxic components of contaminated soil. Nearly pure formulations of insecticides and herbicides were less toxic than were their counterpart commercial formulations. This finding indicates that chemical analysis alone may fail to correctly rate the severity of possible environmental toxicity. Finally, we demonstrate that the lettuce seed phytoassay and kriging techniques can be used to map contamination in a portion of the Rocky Mountain Arsenal site and aid in cleanup decisions. (Author's abstract)
W87-06322

DETERMINATION AND GENOTOXICITY OF NITROGEN HETEROCYCLES IN A SEDIMENT FROM THE BLACK RIVER,
Brigham Young Univ., Provo, UT. Dept. of Chemistry.
For primary bibliographic entry see Field 5C.
W87-06323

EFFECT OF AGE ON SENSITIVITY OF DAPHNIA MAGNA TO CADMIUM, COPPER AND CYANAZINE,
Corvallis Environmental Research Lab., OR.
For primary bibliographic entry see Field 5C.
W87-06324

ROLE OF ARTIFICIAL BURROWS IN HEXAGENIA TOXICITY TESTS: RECOMMENDATIONS FOR PROTOCOL DEVELOPMENT,
Columbia National Fisheries Research Lab., MO.
For primary bibliographic entry see Field 5C.
W87-06327

EVALUATION OF THE ARCHIANNELID DINOPHILUS GYROCILIATUS FOR USE IN SHORT-TERM LIFE-CYCLE TOXICITY TESTS,
Battelle New England Marine Research Lab., Duxbury, MA.
R. S. Carr, M. D. Curran, and M. Mazurkiewicz.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 7, p 703-712, July 1986. 9 fig, 6 tab, 12 ref.

Descriptors: *Bioindicators, *Toxicity, *Dinophilus, *Industrial wastewater, *Effluents, *Water pollution effects, *Life history studies, Population exposure, Reproduction, Sensitivity, Cultures, Performance evaluation.

The use of the archiannelid Dinophilus gyrociliatus O. Schmidt in short-term (7 to 10 d) life-cycle tests with reference toxicants and industrial effluents was evaluated. Culture techniques and test protocols were developed and evaluated. The life history of this archiannelid was also studied and is described. Because this species has a very short life cycle (10 d from juvenile to juvenile at 20 C and 3.0% salinity), reproductive information can be obtained during a short-term test. The results of tests with industrial effluents and reference toxicants indicate that this species is suitable for toxicity testing and appears to be quite sensitive to the industrial effluents tested in this study. The animals are easily cultured and the testing procedure requires very little time for setup and maintenance (1 to 2 h/d). It has been determined that reproductive information can be obtained during a 7-d test that starts with newly emerged juveniles. (Author's abstract)
W87-06336

RELATION OF SURVIVAL TO OTHER ENDPOINTS IN CHRONIC TOXICITY TESTS WITH FISH,
Columbia National Fisheries Research Lab., MO.
F. L. Mayer, K. S. Mayer, and M. R. Ellersieck.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 8, p 737-748, August 1986. 6 tab, 33 ref. EPA Interagency agreement EPA-IAG-AD-14-F-1-556-0.

Descriptors: *Survival, *Toxicity, *Reproduction, *Pollutant identification, *Water pollution effects, *Bioindicators, Organic compounds, Fish, Risk assessment, Population exposure, Growth, Prediction, Costs.

Hazard assessments of chemicals in aquatic organisms often include chronic toxicity testing. The evaluation of duration and of the life stages tested according to standard test methods has led to the development of shorter chronic toxicity tests. A similar evaluation of biological endpoints (i.e., survival, growth and reproduction) could result in tests that are more economical. Endpoints for 28 chemicals and seven fish species in 34 chronic toxicity studies were analyzed. When all endpoints were compared, survival was equal to or more sensitive than all other endpoints 36 to 69% of the time. Individual endpoints were more sensitive than survival 19 to 61% of the time, except for reproduction, which was always more sensitive (although there were few observations). The no observed effect concentration (NOEC) for growth could be predicted from the NOEC for survival by using interendpoint correlations (r = 0.040 to 0.074). Ratios of NOECs for survival to those for all other endpoints examined were 5 or less in 93 to 96% of the comparisons (specific endpoint comparisons ranged from 80 to 100%). The determination of the survival endpoint requires less time and money than does the determination of most other endpoints, and it appears adequate for hazard assessments in the initial stage of estimating chronic toxicity. However, a factor of at least 0.2 should be applied to the estimated no-effect concentrations for survival to include other potential biologically significant effects at least 95% of the time. The factor of 0.2 is based on frequency analyses that resulted in the NOECs for survival being 5 times or less than the NOECs for most other endpoints about 95% of the time. Univariate analyses, however, indicated a range of 0.13 to 0.22 for the factor. A thorough evaluation of other publiahed studies that contain endpoints other then survival should be conducted to define the appropriate factor more accurately. (Author's abstract)
W87-06338

SIMULTANEOUS EVALUATION OF THE ACUTE EFFECTS OF CHEMICALS ON SEVEN AQUATIC SPECIES,
Eastman Kodak Co., Rochester, NY. Health and Environment Labs.
For primary bibliographic entry see Field 5C.
W87-06343

MARGINS OF UNCERTAINTY IN ECOTOXICOLOGICAL HAZARD ASSESSMENT,
Rijksinstituut voor de Volksgezondheid en Milieu-

hygiene, Bilthoven (Netherlands).
W. Sloof, J. A. M. van Oers, and D. de Zwart.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 9, p 841-852, September 1986. 3 fig, 4 tab, 68 ref.

Descriptors: *Analytical methods, *Water pollution effects, *Toxicity, *Regression analysis, *Model studies, Risk assessment, Organic compounds, Prediction, Bioindicators.

Margins of uncertainty in predicting toxicity from one species to another, from acute to chronic exposures and from single species to higher levels of biological organization were determined by regression and correlation analyses. Based on the acute sensitivities of 35 aquatic species to 15 compounds, no species was found to be particularly sensitive to all chemicals and the 95% uncertainty factor (UF) ranged from 3 to 1,985. Analyses of acute and chronic sensitivities for the same species to 164 chemicals resulted in the acute/chronic relationship log NOEC = - 1.28 + 0.95 log L(E)C50(r = 0.89) and the UF of 25.6 (where NOEC is the no observed effect concentration). Comparison of the lowest acute and corresponding ecosystem effect levels for 34 chemicals indicated the relationship log NOEC(ecosystems) = -0.55 + 0.81 log L(E)C50(r = 0.77) and the UF of 85.7. As to the predictability of ecosystem effect levels from chronic single-species data, the following relationship was found: log NOEC(ecosystems) = 0.63 + 0.85 log NOEC (r = 0.85), with a UF of 33.5. These data indicate that acute testing is not pointless; it offers a statistical base for the use of acute toxicity information in the hazard assessment of chemicals in the aquatic environment. (Author's abstract)
W87-06344

SEDIMENT QUALITY CRITERIA FROM THE SEDIMENT QUALITY TRIAD: AN EXAMPLE,
E.V.S. Consultants Ltd., North Vancouver (British Columbia).
P. M. Chapman.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 11, p 957-964, November 1986. 6 fig, 3 tab, 17 ref.

Descriptors: *Pollutant identification, *Sediments, *Bioassay, *Organic compounds, *Fish pathology, Histopathology, Puget Sound, Aromatic hydrocarbons, Polychlorinated biphenyls.

Broad-scale comparative data for sediment chemistry, sediment bioassays and bottom fish histopathology are used to derive quantitative site-specific sediment criteria for three representative chemical contaminants in Puget Sound, Washington. The criteria, in terms of concentrations at or below which biological effects were shown to be minimal, are (dry weight sediment): lead, 50 microgram(ug)/g (ppm); combustion polyaromatic hydrocarbons, 3.8 ug/g; total polychlorinated biphenyls, 0.1 ug/g. (Author's abstract)
W87-06351

DEVELOPMENT AND VALIDATION OF SITE-SPECIFIC WATER QUALITY CRITERIA FOR COPPER,
Environmental Research Lab.-Duluth, MN.
A. R. Carlson, H. Nelson, and D. Hammermeister.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 11, p 997-1012, November 1986. 7 fig, 9 tab, 14 ref.

Descriptors: *Analytical methods, *Water quality standards, *Copper, *Toxicity, *Aquatic animals, *Bioindicators, Population exposure, Rivers, Downstream, Heavy metals.

Comparative acute toxicity values for Ceriodaphnia dubia, Scapholeberis sp. and Pimephales promelas exposed to copper were used to calculate water effect ratios (e.g., site water LC50 value/reference water LC50 value), which reflect the difference in the biological availability and/or toxicity of copper between water from the Naugatuck River, Connecticut and Lake Superior reference water. These ratios were used to modify U.S. Environmental Protection Agency (EPA) ambient aquatic life criteria for copper to site- and station-specific criteria, using the indicator procedure of the U.S. EPA guidelines for deriving site-specific water quality criteria. A water effect ratio of 1.0 was established using unpolluted upstream water, resulting in a site-specific criterion maximum concentration (CMC) and criterion continuous concentration (CCC) of 8.7 and 6.2 microgram(ug)/L copper, respectively. Mean water effect ratios of 3.9 to 7.0, reflective of reduced biological availability and/or toxicity of copper, were determined for four successive downstream stations where the water contained copper and other industrial and domestic wastes. The resulting station-specific CMCs and CCCs ranged from 32 to 57 and 22 to 39 ug/L copper, respectively. These copper criteria were compared with effluent-contributed ambient copper concentrations and ecological survey data from each downstream station to ascertain impact on aquatic life. It was concluded that the national and site-specific criteria derived for copper would be protective of the river's aquatic life because a relatively healthy aquatic community existed where these criteria were exceeded slightly. Whether or not the station-specific criteria were protective could not be determined because these criteria were not exceeded at stations with healthy communities; however, where they were exceeded, impaired aquatic communities were evident. Generally, C. dubia survival and young production data from receiving water tests and copper addition tests, conducted just prior to the acute toxicity tests, were also indicative of reduced copper biological availability and/or toxicity in the Naugatuck River at downstream stations. (Author's abstract)
W87-06354

SCREEN DEVICE TO ELIMINATE 'FLOATERS' IN DAPHNIA MAGNA TOXICITY TESTS,
Battelle Columbus Div., OH.
J. H. Dean, and G. M. DeGraeve.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 12, p 1055-1057, December 1986. 2 fig, 6 ref.

Descriptors: *Bioindicators, *Water pollution effects, *Toxicity, *Analytical methods, *Screen device, *Daphnia, Floaters, Effluents, Water column.

Toxicity tests for research and regulatory compliance (premanufacturing product testing and complex effluent testing for NPDES discharge permits) are commonly conducted using Daphnia magna. This organism is easy to culture and has been proven to be sensitive to a wide range of test substances. However, a problem commonly seen in testing this organism has been the presence of organisms trapped at the surface of test waters, frequently called 'floaters'. Because these 'floaters' are trapped at the surface instead of swimming in the water column, their exposure conditions are difficult to define and are not environmentally relevant. Therefore, the results obtained from tests in which 'floaters' are found are difficult to interpret. A screen device was designed to physically prevent the Daphnia from touching the water surface. The effectiveness of the device was evaluated using several complex effluents. (Alexander-PTT)
W87-06359

TEMPORAL AND SPATIAL VARIABILITY IN ZN, CR, CD AND FE CONCENTRATIONS IN OYSTER TISSUES (CRASSOSTREA BRASILIANA LAMARCK, 1819) FROM SEPETIBA BAY, BRAZIL,
Universidade Federal do Rio de Janeiro (Brazil). Inst. de Biofisica.
For primary bibliographic entry see Field 5B.
W87-06364

ALKYLLEAD COMPOUNDS IN SURFACE AND POTABLE WATERS,
Essex Univ., Colchester (England). Dept. of Chemistry.
M. Radojevic, and R. M. Harrison.
Environmental Technology Letters ETLEDB, Vol. 7, No. 10, p 519-524, October 1986. 2 fig, 2 tab, 16 ref.

Descriptors: *Pollutant identification, *Path of pollutants, *Portable water, *Water analysis, *Surface water, *Lead compounds, Gas chromatography, Atomic absorption spectrometry, Spectral analysis.

Gas chromatography/atomic absorption spectrometry was used to determine specific alkyllead compounds in surface and potable water samples and in rainwater. For the first time, ionic alkyllead species were identified in potable waters at very low levels with concentrations up to 3.6 nanogram Pb/l. No tetraalkyllead compounds were found in any of the samples. Laboratory studies demonstrated that these species decompose rapidly in aqueous samples to trialkyllead, the most common form of organic lead in the environmental samples. (Rochester-PTT)
W87-06369

CHROMIUM, NICKEL, COPPER, ZINC, ARSENIC, SELENIUM, CADMIUM, MERCURY AND LEAD IN DUTCH FISHERY PRODUCTS 1977-1984,
Rijks-Kwaliteitsinstituut voor Land-en Tuinbouwprodukten, Wageningen (Netherlands).
G. Vos, and J. P. C. Hovens.
The Science of the Total Environment STENDL, Vol. 52, No. 1/2, p 25-40, June 1986. 6 tab, 29 ref.

Descriptors: *Pollutant identification, *Heavy metals, *Fishery products, *Netherlands, *Foods, *Tissue analysis, Chromium, Nickel, Copper, Zinc, Arsenic, Selenium, Cadmium, Mercury, Lead, Cod, Sole, Plaice, Herring, Eel, Pike-perch, Shrimp, Mussels, Trace elements, Fish.

Within the framework of a monitoring program, carried out by order of the Dutch Ministry of Agriculture and Fisheries, fishery products from Dutch coastal waters, estuaries, and inland waters were investigated for the presence of trace elements. Fishery products investigated for the period 1977-1984 included sole, code, plaice, herring, eel, pike-perch, shrimp, and mussel, in which the elements Cr, Ni, Cu, Zn, As, Se, Cad, Hg, and Pb were determined. The results are compared with data from the literature and with the trace elements usually found in other animal products. The daily intake of trace elements in The Netherlands through the consumption of Dutch fishery products is calculated. (Author's abstract)
W87-06388

ANALYSES OF CHLORINATED STYRENES IN ENVIRONMENTAL SAMPLES USING NEGATIVE ION CHEMICAL IONIZATION MASS SPECTROMETRY,
Senter for Industriforskning, Oslo (Norway).
T. Ramdahl, G. E. Carlberg, and P. Kolsaker.
The Science of the Total Environment STENDL, Vol. 48, No. 3, p 147-155, February 1986. 4 fig, 2 tab, 19 ref.

Descriptors: *Pollutant identification, *Water analysis, *Chlorinated styrenes, *Mass spectrometry, Gas chromatography, Cod liver, Cod filet, Negative ion chemical ionization, Measuring instruments, Analytical methods, Organic compounds, Spectral analysis.

A method is presented for the separation and identification of chlorinated styrene isomers with fully chlorinated aromatic nuclei in environmental samples. Gas chromatography combined with negative ion chemical ionization mass spectrometry was used. The method was applied to combined codfish liver and filet extract. All the possible chlorostyrenes with fully chlorinated aromatic nuclei were detected in this sample. (See also W87-06394) (Author's abstract)
W87-06393

IDENTIFICATION OF CHLORINATED COMPOUNDS IN THE SPENT CHLORINATION LIQUOR FROM DIFFERENTLY TREATED SULPHITE PULPS WITH SPECIAL EMPHASIS ON MUTAGENIC COMPOUNDS,
Senter for Industriforskning, Oslo (Norway).
G. E. Carlberg, H. Drangsholt, and N. Gjos.

The Science of the Total Environment STENDL, Vol. 48, No. 3, p 157-167, February 1986. 1 fig, 1 tab, 13 ref.

Descriptors: *Effluents, *Pollutant identification, *Mutagens, *Wastewater treatment, *Chlorinated hydrocarbons, *Chlorination liquor, Kraft mill wastes, Oxygen delignification, Alkali treatment, Industrial wastewater, Organic compounds.

About 80 compounds present in the spent chlorination liquor from the bleaching of sulfite pulp were identified. These compounds were compared with those identified in kraft bleaching pulp effluent, with special emphasis on mutagens. The influence of oxygen delignification, before chlorination and alkali treatment to the spent liquor, on the composition of the liquors also was studied. (See also W87-06939) (Author's abstract)
W87-06394

ENVIRONMENTAL CONTAMINATION BY LEAD AND CADMIUM IN PLANTS FROM URBAN AREA OF MADRID, SPAIN,

Consejo Superior de Investigaciones Cientificas, Madrid (Spain). Inst. de Quimica Organica General.
L. M. Hernandez, M. C. Rico, M. J. Gonzalez, and M. A. Hernan.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 2, p 203-208, February 1987. 2 fig, 3 tab, 11 ref.

Descriptors: *Monitoring, *Bioindicators, *Pollutant identification, *Air pollution, *Heavy metals, *Plant tissues, *Leaves, *Lead, *Cadmium, *Madrid, Spain, Metals, Seasonal variation, Rainfall, Pollutants, Urban areas, Traffic intensity.

Monitoring atmospheric pollution using biological materials as metal indicators is a relatively cheap, simple and reliable method. Lead and cadmium levels in rose-bay leaves collected from 15 sites in the city of Madrid were determined. Cadmium showed the lower mean level, with a range of 0.34 to 1.68 ppm, while the range for lead was 8.1 to 178.3 ppm. The effect of seasonal change was insignificant for cadmium, but the lead concentration varied with a decrease during the growing season and an increase from July though January which was attributed to water loss, air dryness and decreased growth. Correlation among residues of lead, cadmium, traffic intensity, and rainfall were calculated. The residues of lead were not correlated with rainfall, but a highly significant positive correlation between lead levels and traffic intensity was observed. The residues of cadmium were not correlated with the residues of lead, traffic intensity or rainfall. (Wood-PTT)
W87-06420

DETERMINATION OF HIGH OZONE CONCENTRATIONS IN AIR,

Bodensee-Wasserversorgung, Stuttgart (Germany, F.R.).
D. Maier, and G. E. Kurzmann.
IN: Analytical Aspects of Ozone Treatment of Water and Wastewater, Lewis Publishers, Chelsea, Michigan. 1986. p 271-292, 5 fig, 6 tab, 12 ref.

Descriptors: *Ozone, *Atmosphere, *Chemical analysis, Hydrogen ion concentration, Potassium iodide, Calorimetry, Titration, Photometry.

Efforts were made in Switzerland and in the U.S. to develop a uniform and comparable ozone analytical method. In these tests, which were limited to determination of the ozone content in the atmosphere only, concentrations up to one ppm ozone were measured. The classical method to determine ozone in the gaseous phase, is the oxidation of iodide ion to iodine with the subsequent titration of iodine with sodium thiosulfate. Considering the stoichiometry of the reaction between iodine and ozone, there exist some controversial opinions, especially when dealing with high ozone concentrations (> 10 ppm). Based on these considerations, an ozone working group was formed on April 16, 1976, by the Association of Water Supply Bodensee in Überlingen Sussenmuhle, and undertook the task of examining more closely in a first phase of its studies the controversial details of ozone determination in the gas phase using the potassium iodide method, and included in this program the different methods of instrumental analysis. The experimental program of the Work Group was completed in three sessions. In detail the following effects were studied: (a) the effect of the velocity of flow of the measured gas; (b) the effect of pH; (c) the effect of buffering of the KI solution; (d) the effect of concentration of the KI solution; (e) the effect of dispersion of the gas in the KI solution; and (f) the effect of ozone concentration. This paper presents and briefly discusses each of these effects, as well as the following measuring techniques: (1) potassium iodide calorimetry; (2) titrimetric determination by the KI method; (3) calorimetric determination using the enthalpy method; and (4) photometric determination by the UV method. (See also W87-06492) (Lantz-PTT)
W87-06510

EVALUATION OF OZONE CALIBRATION PROCEDURES: PROJECT SUMMARY,

Environmental Monitoring Systems Lab., Research Triangle Park, NC.
K. A. Rehme, J. C. Puzak, M. E. Beard, C. F. Smith, and R. J. Paur.
IN: Analytical Aspects of Ozone Treatment of Water and Wastewater, Lewis Publishers, Chelsea, Michigan. 1986. p 293-301, 5 tab.

Descriptors: *Chemical analysis, *Ozone, *Air pollution, Calibrations, Potassium iodide, Photometry, Ultraviolet radiation, Titration, Nitric oxide, Potassium iodide.

Four candidate calibration procedures for the determination of photochemical oxidants in the atmosphere were considered promising replacements for the 1% neutral buffered potassium iodide (NBKI) procedure in use at the time this project was undertaken: ultraviolet (UV) photometry, gas phase titration with excess nitric oxide (GPT-NO), gas phase titration with excess ozone (GPT-O3), and an improved potassium iodide technique using a boric acid buffered potassium iodide reagent (BAKI). Each of these procedures had demonstrated results of adequate precision and accuracy under ideal conditions. All candidate procedures were evaluated to review the procedural descriptions and to assess critical performance parameters. Variability studies then were conducted to estimate the precision and accuracy of the calibrations. The information was used to assess the relative performance of each procedure for calibrating O3 reference methods. The reproducibility of a given method, defined as the 95% confidence interval of the difference in the slopes of two calibrations performed by different operators using different calibration system on different days, was also estimated for each of the four methods. These data indicated that the UV photometric calibration procedures (reproducibility 3.4%), and that UV photometers employed for calibration purposes have no significant bias (mean slope (1.0037). However, its accuracy for measuring O3 concentrations confirmed by its direct relationship to a well established O3 absorption coefficient as well as comparisons of independent UV photometers that showed agreement within + or - 1.5%. Independent use of the BAKI procedure for the direct calibration of O3 reference methods was allowed for an 18-month transition period to permit agencies to adopt the new UV calibration procedure. (See also W87-06492) (Lantz-PTT)
W87-06511

ECOPHYSIOLOGICAL ADAPTATIONS OF ANAEROBIC BACTERIA TO LOW PH: ANALYSIS OF ANAEROBIC DIGESTION IN ACIDIC BOG SEDIMENTS,

Wisconsin Univ.-Madison. Dept. of Bacteriology.
S. Goodwin, and J. G. Zeikus.
Applied and Environmental Microbiology AEMIDF, Vol. 53, No. 1, p 57-64, January 1987. 5 fig, 7 tab, 24 ref. DOE Grant DE-FG02-85ER13376.

Descriptors: *Pollutant identification, *Hydrogen ion concentration, *Acidity, *Anaerobic bacteria, *Anaerobic digestion, *Sediments, *Bogs, *Ecological effects, *Physiological ecology, Environmental effects, Ecology, Adaptation, Acidic soils, Bacteria, Anaerobic conditions, Digestion, Wisconsin, Organic matter, Carbon dioxide, Methane, Hydrogen, Metabolism, Metabolites, Lactobacillus, Clostridium, Isotope studies.

The dynamics of anaerobic digestion were examined in the low-pH sediments of Crystal Bog in Wisconsin. The sediments (pH 4.9) contained 71% organic matter and the following concentrations of dissolved gases (micromoles per liter): CO2, 1140; CH4, 490; and H2, 0.01. The rate of methane production was 6.2 micromol/liter of sediment per hour, which is slower than eutrophic, neutral sediments. Microbial metabolite processes displayed the following pH optima: hydrolysis reactions, between 4.2 and 5.6; aceticlastic methanogenesis, 5.2; and hydrogen-consuming reactions, 5.6. The turnover rate constants for key intermediary metabolites were (per hour): glucose, 1.10; lactate, 0.277; acetate, 0.118; and ethanol, 0.089. The populations of anaerobes were low, with hydrolytic groups (1000000/ml) several orders of magnitude higher than methanogens (100/ml). The addition of carbon electron donors to the sediment resulted in the accumulation of hydrogen, whereas the addition of hydrogen resulted in the accumulation of fatty acids and the inhibition of hydrogen-producing acetogenic reactions. Strains of Lactobacillus, Clostridium, and Sarcina ventriculi were isolated from the bog, and their physiological attributes were characterized in relation to hydrolytic process functions in the sediments. Evidence was presented to show that the pH present in the bog sediments alter anaerobic digestion processes so that total biocatalytic activity is lower, but the general carbon and electron flow pathways are similar to those of neutral anoxic sediments. (Author's abstract)
W87-06544

NAPHTHALENE BIODEGRADATION IN ENVIRONMENTAL MICROCOSMS: ESTIMATES OF DEGRADATION RATES AND CHARACTERIZATION OF METABOLITES,

National Center for Toxicological Research, Jefferson, AR.
For primary bibliographic entry see Field 5B.
W87-06545

COMPARISON OF SOME PHYSICOCHEMICAL PARAMETERS OF HUMIC SUBSTANCES ISOLATED FROM THREE DIFFERENT AQUATIC ECOSYSTEMS,

Polish Academy of Sciences, Poznan. Dept. of Agrobiology and Forestry.
B. Szpakowska, J. Pempkowiak, and I. Zyczynska-Baloniak.
Archiv fuer Hydrobiologie AHYBA4, Vol. 108, No. 2, p 259-267, December 1986. 2 fig, 3 tab, 27 ref. Polish Academy of Sciences Grant MR-II/23 and MR-I/15.

Descriptors: *Humic acids, *Path of pollutants, *Heavy metals, *Cadmium, *Lead, *Metal complexes, Baltic Sea, Vistula River, Cations, Chemical analysis, Infrared spectroscopy, Heavy metals, Phenols, Cultivated lands, Spectral analysis, Aromatic compounds, Precipitation.

Humic substances were isolated from three different water bodies containing the following concentrations: in water from a canal situated in farmed land, 25.0 mg/cu dm, in water from the Vistula River 9.1 mg/cu dm and in water from the Gulf of Gdansk 1.3 mg/cu dm. Humic substances were isolated by sorption on Amberlite XAD-2 resin. Physicochemical properties of these substances were compared via elemental analysis, IR, UV and VIS absorption spectra. It has been established that humic substances isolated from the canal water contain aromatic rings and have more acidic functional groups (phenolic, carboxylic) compared to marine humic substances. Complexing properties of the substances towards Cd and Pb were investigated using anodic stripping voltammetry. The examined substances bind 1.3-13.2 microgram/mg of Cd and 0.21-7.71 microgram/mg of Pb, depending on sample origin. The results confirm that low

molecular weight humic substances are strong organic ligands, form stable chelates with metal cations, and introduce and maintain in circulation considerable amounts of cations. (Airone-PTT)
W87-06561

INTERPRETATION OF GAS CHROMATOGRAPHIC DATA IN SUBSURFACE HYDROCARBON INVESTIGATIONS,
Amoco Corp., Tulsa, OK.
R. B. Senn, and M. S. Johnson.
Ground Water Monitoring Review GWMRDU, Vol. 7, No. 1, p 58-63, Winter 1987. 13 fig, 2 ref.

Descriptors: *Petroleum products, *Gas chromatography, *Groundwater pollution, *Aromatic compounds, *Water pollution sources, Migration, Hydrocarbons, Chemical analysis, Biodegradation, Benzene.

Capillary column gas chromatography (GC) is extremely useful in investigations of subsurface contamination by petroleum hydrocarbons. Fluid samples collected from observation wells are evaluated by GC methods to detect and analyze petroleum hydrocarbons in dissolved and liquid phases. The presence, types and concentrations of many petroleum-derived hydrocarbons dissolved in groundwater can be determined. GC can also be used to estimate the degree of degradation of sampled liquid hydrocarbon product and this information is helpful in estimating the length of time the product has been in the subsurface. Determination of the hydrocarbon source and migration path can be made from GC analysis of fluid samples collected at two or more locations. Several examples are given which exemplify these applications. Interpretation of a gas chromatogram in the laboratory without considering the hydrogeologic setting from which the sample was taken (and how the sample was collected as well) may result in inaccurate or incomplete conclusions. (Airone-PTT)
W87-06571

DETECTING CHANGES IN GROUND WATER QUALITY AT REGULATED FACILITIES,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
For primary bibliographic entry see Field 5G.
W87-06573

SPECTROPHOTOMETRIC DETERMINATION OF COPPER IN ENVIRONMENTAL SAMPLES BY SOLID-LIQUID EXTRACTION OF ITS 9,10-PHENANTHRENEQUINONE MONOXIMATE COMPLEX INTO MOLTEN NAPHTHALENE,
Indian Inst. of Tech., New Delhi. Dept. of Chemistry.
A. Wasey, B. K. Puri, M. Katyal, and M. Satake.
Journal of Environmental Analytical Chemistry, Vol. 24, No. 3, p 169-182, 1986. 2 fig, 5 tab, 17 ref.

Descriptors: *Spectrophotometry, *Copper, *Environmental samples, *Solid liquid extraction, *Analytical methods, *Sample preparation, Naphthalene, Wastewater, Beer, Wine, Human hair, Beer's law, Extraction, Complexes, Metals, Ions, Sensitivity.

A fairly selective and sensitive spectrophotometric method was developed for determination of copper after extraction of its 9,10 phenanthrenequinone monoximate complex into molten naphthalene in the pH range of 6.1-8.4. At room temperature, the solid naphthalene containing the metal complex is separated by filtration, dissolved in dimethylformamide (DMF) and the absorbance measured at 470 nm against the reagent blank. Beer's law is obeyed in the concentration range 0.0-9.6 micrograms of copper in 10 ml of DMF. The molar absorptivity and sensitivity were 63000 l/mol/cm and 0.001 microgram/sq cm, respectively. The interference of various ions was studied and the method was applied for the determination of copper in various standard reference materials, beer, wines, human hair and environmental samples. (Author's abstract)
W87-06591

FATE OF ATRAZINE AND TRIFLURALIN FROM AN INDUSTRIAL WASTE DUMPING AT THE LLOBREGAT RIVER. PRESENCE IN FISH, RAW AND FINISHED WATER,
Instituto de Quimica Bio-Organica, Barcelona (Spain).
For primary bibliographic entry see Field 5B.
W87-06592

SULFUR CONSTITUENTS IN SOILS AND STREAMS OF A WATERSHED IN THE ROCKY MOUNTAINS OF ALBERTA,
State Univ. of New York Coll. of Environmental Science and Forestry, Syracuse.
For primary bibliographic entry see Field 5B.
W87-06601

5B. Sources Of Pollution

MODE OF ACTION OF CHLORINE DIOXIDE WITH CERTAIN NITROGENOUS COMPOUNDS IN AN AQUEOUS MEDIUM (MODE D'ACTION DU BIOXYDE DE CHLORE SUR QUELQUES COMPOSES ORGANIQUES AZOTES EU MILEU AQUEUX DILUE),
Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
For primary bibliographic entry see Field 5F.
W87-05927

ESTIMATING THE RATE OF GENERATION OF ACID DRAINAGE PRODUCTS IN COAL STORAGE HEAPS,
Queensland Univ., Brisbane (Australia). Dept. of Chemical Engineering.
D. E. Gottschlich, P. R. F. Bell, and P. F. Greenfield.
Environmental Technology Letters ETLEDB, Vol. 7, No. 1, p 1-12, January 1986. 6 fig, 3 tab, 31 ref.

Descriptors: *Water pollution sources, *Mine wastes, *Acid mine water, *Coal, *Iron sulfides, *Acidic water, *Acid mine drainage, Oxidation, Design criteria, Wastewater facilities, Temperature, Prediction.

The rate of oxidation of iron sulfides contained in reject coal from a coal washery was measured in small scale reactors designed to simulate the conditions in a storage heap. The results from such tests compared well with the measured levels of oxidation products generated in acid waste streams emanating from large scale columns (scale-up factor of 200), indicating the value of the procedure in predicting some of the variables necessary for the design of a treatment facility. As previous studies have shown, the rate of oxidation was constant up to a critical point when the oxidation rate dropped noticeably. During this period, the oxidation rate varied from 61.4-206.4 mg Fe/day/kg coal for temperatures ranging from 25 C to 37 C. (Author's abstract)
W87-05936

MUSTY ODOR FROM BLUE-GREEN ALGA, PHORMIDIUM TENUE IN LAKE KASUMIGAURA,
National Inst. for Environmental Studies, Tsukuba (Japan).
N. Sugiura, O. Yagi, and R. Sudo.
Environmental Technology Letters ETLEDB, Vol. 7, No. 2, p 77-86, February 1986. 11 fig, 18 ref.

Descriptors: *Water pollution sources, *Odor-producing algae, *Cyanophyta, *Pollutant identification, *Japan, *Trichomes, *Lake Kasumigaura, 2-methylisoborneol, Lakes, Algae, Odors.

A musty odor occurred in Lake Kasumigaura (Japan) in July 1980, November 1980-January 1981, and July 1981. A musty odorous compound, 2-methylisoborneol, was detected from the water by adsorbent-solvent desorption. A good relationship was observed between the musty odor occurrence and the trichome numbers of Phormidium tenue. One trichome of P. tenue produced musty odor of threshold odor number 0.08 to 0.12. Gas chromatography studies confirmed the presence of 2-methylisoborneol in unialgal cultures of Phormidium tenue, suggesting that this compound was the main contributor to the observed musty odor occurrences in Lake Kasumigaura. (Rochester-PTT)
W87-05941

OZONATION OF AQUATIC ORGANIC MATTER AND HUMIC SUBSTANCES: AN ANALYSIS OF SURROGATE PARAMETERS FOR PREDICTING EFFECTS ON TRIHALOMETHANE FORMATION POTENTIAL,
Arizona Univ., Tucson. Dept. of Civil Engineering and Engineering Mechanics.
For primary bibliographic entry see Field 5F.
W87-05943

EFFECT OF THREE SLUDGE PROCESSING OPERATIONS ON THE FATE AND LEACHABILITY OF TRACE ORGANICS IN MUNICIPAL SLUDGES,
Environmental Protection Service, Burlington (Ontario). Waste Water Technology Centre.
For primary bibliographic entry see Field 5D.
W87-05945

MEASUREMENT OF COPPER IN INDIVIDUAL AQUATIC INSECT LARVAE,
Plymouth Polytechnic (England). Faculty of Science.
For primary bibliographic entry see Field 5A.
W87-05946

SPECIATION OF HEAVY METALS IN THE SLUDGE OF AN OXIDATION POND (SPECIATION DES METAUX LOURDS PRESENTS DANS LES BOUES D'UN BASSIN DE LAGUNAGE NATUREL),
Ecole Nationale de la Sante Publique, Rennes (France). Lab. de Genie Sanitaire.
For primary bibliographic entry see Field 5D.
W87-05956

HYDROCARBON POLLUTION FROM MARINAS IN ESTUARINE SEDIMENTS,
Virginia Inst. of Marine Science, Gloucester Point.
E. A. Voudrias, and C. L. Smith.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 22, No. 3, p 271-284, March 1986. 6 fig, 3 tab, 31 ref.

Descriptors: *Hydrocarbons, *Path of pollutants, *Fate of pollutants, *Marinas, *Estuaries, *Water pollution sources, *Sediments, Estuarine environment, Aromatic hydrocarbons, Aliphatic hydrocarbons.

One of the fates of petroleum hydrocarbons in the aquatic environment is adsorption on or incorporation into particulate matter and final deposition and incorporation into surface sediments. There they may persist for some years resulting in some degree of exposure to the benthic ecosystem. The high degree of persistence in sediments is related to the fact that hydrocarbons are well protected from bacterial degradation, especially if the sediments are anaerobic or become so because of pollution. Hydrocarbons surviving biodegradation are buried in deeper sediment. The purpose of this study was to determine differences in hydrocarbons of bottom sediments in 3 eastern Virginia creeks. Two of the creeks support considerable marine activity, including pleasure boat marinas, boat repair facilities, and commercial fishing operations. The third creek, which served as a control, is seldom used by boats, and is surrounded by marsh and woodland. Sediments from the creeks with marinas contained significantly higher levels of both aromatic and aliphatic hydrocarbons than did the control. Differences in the concentrations of certain oil-pollution indicators, such as the 17alpha, 21beta-hopane homologs and phytane, and low molecular weight aromatic hydrocarbons, are indicative of light petroleum fractions. Most of the aromatic hydrocarbons from all creeks, however, appear to have a pyrogenic origin. Although hy-

drocarbons from three probable origins (petroleum, pyrogenesis, and recent biosynthesis) were detected at all locations, the petroleum-derived and pyrogenic hydrocarbons were of only minor importance relative to the biogenic hydrocarbons in the control creek. (Authors' abstract)
W87-05969

CHEMICAL COMPOSITION OF HIGHWAY DRAINAGE WATERS: IV. ALKYLLEAD COMPOUNDS IN RUNOFF WATERS,
Essex Univ., Colchester (England). Dept. of Chemistry.
R. M. Harrison, M. Radojevic, and S. J. Wilson.
The Science of the Total Environment STENDL, Vol. 50, p 129-137, April 1986. 2 fig, 2 tab, 12 ref.

Descriptors: *Water pollution sources, *Pollutant identification, *Drainage water, *Runoff, *Lead compounds, Chemical composition, Rain.

Highways are a major source of metals, particularly inorganic lead, in the environment. Two percent of the tetraethyllead (TAL) in motor gasoline may reach the atmosphere unchanged. Alkyllead compounds in road drainage water samples collected during seven storm events have been analysed using a sensitive gas chromatography - atomic absorption technique. The most commonly observed alkyllead species were tetraethyllead, triethyllead, and trimethylead. Similar compounds were also observed in rainwater collected at the site, but not in road surface dust or bottom sediment from the drainage channel. In all samples analysed the concentration of alkyllead was less than 5 percent of the dissolved (less than 0.45 micron) inorganic lead. It is postulated that washout of alkyllead from the atmosphere is the major source of alkyllead compounds in the drainage waters analysed. Alkyllead species were also identified in rainwater collected at other sites. (Authors' abstract)
W87-05973

CALCITE DEPOSITION FROM CARBONACEOUS PARTICLES SCAVENGED BY SNOW,
Bologna Univ. (Italy). Ist. di Geologia.
M. del Monte, C. Sabbioni, and G. Zappia.
The Science of the Total Environment STENDL, Vol. 50, p 147-163, April 1986. 5 fig, 2 tab, 30 ref. CNR-CEE Joint Program, Contract ENVIRONMENT 757 I/SB.

Descriptors: *Air pollution, *Calcite, *Deposition, *Carbonates, *Snow, *Scavenging, *Chemical reactions, *Path of pollutants, Precipitation, Aerosols.

Carbonaceous particles produced by the combustion of fuel oil in electric power plants, nucleate, under laboratory controlled conditions (high water vapor level, absence of SO2 and NOx), a wide series of crystalline particles. Gypsum, associated with vanadates and silica, was the main mineralogical species found. Fly ash, also emitted by coal-fired power plants, shows crystallite growth of gypsum under laboratory conditions during storage. The formation of gypsum is attributed to the reaction of calcium and sulphur, which are particularly enriched in the silicatic matrix constituting the fly ash. The melting of snow precipitating in an urban area and deposited on an inert substrate (gres) is shown to give rise to the formation of a hard deposit. The deposit is mainly composed of calcium carbonate (CaCO3, 85%) and appears to include components of atmospheric aerosol, such as soot, minerals (silicates, oxides, carbonates) and rock fragments. The carbonaceous particles (soot), which are present in high concentrations, are recognized to be the residual product of oil-combustion processes. The soot was found to nucleate several species, among which calcium sulfate bihydrate (gypsum: CaSO4.2H2O) is prevalent. Under the particular chemico-physical conditions reported herein, the calcium iron supplied by the soot causes CaCO3 precipitation, while the nucleation of CaSO4.2H2O is prevented. Finally, the hypothesis that the calcite found in atmospheric aerosol may partially be of similar origin is advanced. (Authors' abstract)
W87-05975

HEAVY METAL CONCENTRATIONS IN CATERPILLARS FED WITH WASTE-GROWN VEGETABLES,
Chinese Univ. of Hong Kong, Shatin. Dept. of Biology.
For primary bibliographic entry see Field 5E.
W87-05978

HEAVY METALS IN LANDFILL LEACHATE,
Geraghty and Miller, Inc., Hackensack, NJ.
C. Ray, and P. C. Chan.
International Journal of Environmental Studies IJEVAW, Vol. 27, No. 3/4, p 225-237, 1986. 1 fig, 6 tab, 34 ref.

Descriptors: *Path of pollutants, *Wastewater treatment, *Water pollution treatment, *Heavy metals, *Land disposal, *Leachates, Aerobic treatment, Anaerobic treatment, Adsorption.

Sanitary landfill leachate is known to contain varying concentrations of different heavy metals, in addition to other contaminants. The treated leachate is often introduced to publicly owned treatment works for further treatment prior to disposal to receiving water but the heavy metals are not removed. Therefore, they pose a potential detrimental effect to the entire biosphere. Results based upon bench/laboratory and pilot-scale studies reveal that both biological (aerobic and anaerobic) and physico-chemical processes are feasible for the removal of leachate heavy metals. The aerobic process was shown to be superior to the anaerobic process. The process of adsorption was found to be superior to ion exchange. The advantage of physico-chemical processes over the biological process is that the former can handle excessively high concentrations of heavy metals in the influent without the detrimental effect of toxicity. Research conducted at the New Jersey Institute of Technology with fly ash and clay sorbents for the removal of heavy metals from industrial sludge leachates showed these materials to be effective with the controlled flow rates and sorbent arrangements. To date, field studies are still scarce. It is difficult to make any judgement on the field performance of these bench and pilot-scale studies. (Authors' abstract)
W87-05988

VARIATION IN PRECIPITATION QUALITY DURING A 40-HOUR SNOWSTORM IN AN URBAN ENVIRONMENT--DENVER, COLORADO,
Geological Survey, Arvada, CO.
For primary bibliographic entry see Field 2C.
W87-05996

ENVIRONMENTAL CHEMISTRY OF MAHAWELI RIVER, SRI LANKA,
Sri Lanka Univ., Peradeniya. Environmental Geochemistry Research Group.
C. B. Dissanayake, and S. V. R. Weerasooriya.
International Journal of Environmental Studies IJEVAW, Vol. 28, No. 2/3, p 207-223, 1986. 9 fig, 4 tab, 22 ref.

Descriptors: *Aquatic environment, *Chemical properties, *Sri Lanka, *Water quality, *Urban areas, *Developing countries, *Water pollution sources, Environment, Monitoring, Heavy metals, Vanadium, Zinc, Copper, Lead, Cadmium, Cobalt, Nutrients, Potable water.

The water pollution levels of Mahaweli River, the longest river in Sri Lanka, were monitored to probe the impacts of the urban environment in a developing country. Chemical quality was found to be largely controlled by natural factors. However, vanadium, zinc, and copper showed higher concentrations. Pb and Cd showed a correlation coefficient of r = 0.58 for each other, and Co showed a highly significant correlation of r = 0.98 with Cu. The lack of correlation of Pb and Cd with the total dissolved solids (TDS) indicates an anthropogenic input of Pb and Cd into the aquatic environment. In general, the chemical quality of the water in the Mahaweli river is satisfactory for most purposes, none of the major dissolved constituents and nutrients exceeding the limit suggested by the WHO for potable water. (Author's abstract)
W87-05998

OCCURRENCE AND SPECIATION OF ORGANOMETALLIC COMPOUNDS IN FRESHWATER SYSTEMS,
Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 5A.
W87-06005

TOXIC PEPTIDES FROM FRESHWATER CYANOBACTERIA (BLUE-GREEN ALGAE). I. ISOLATION, PURIFICATION AND CHARACTERIZATION OF PEPTIDES FROM MICROCYSTIS AERUGINOSA AND ANABAENA FLOS-AQUAE,
Chemical Research, Development and Engineering Center, Aberdeen Proving Ground, MD.
For primary bibliographic entry see Field 5A.
W87-06009

LEGIONELLA IN COOLING TOWERS,
Environmental Protection Agency, Burlington, VT. Vermont Field/Special Projects Office.
For primary bibliographic entry see Field 5A.
W87-06012

POLYCYCLIC AROMATIC HYDROCARBON METABOLISM IN MULLETS, CHELON LABROSUS, TREATED BY POLYCHLORINATED BIPHENYLS,
Bordeaux-1 Univ., Talence (France). Lab. of Food Toxicology.
J. F. Narbonne, P. Suteau, M. Daubeze, and C. Audy.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 1, p 53-57, January 1987. 3 tab, 11 ref.

Descriptors: *Aromatic compounds, *Hydrocarbons, *Metabolism, *Polychlorinated biphenyls, *Mullet, *Fate of pollutants, *Biodegradation, *Water pollution effects, Degradation, Fish physiology, Animal physiology, Growth, Enzymes, Toxicity, Water pollution.

The metabolism of aromatic hydrocarbons was compared between control and PCB-induced estuarine fish (grey mullets), the latter injected with Phenoclor DP6. It was found that cytochrome P-450 content significantly increased in the treated group (+ 68%), and hepatic mixed function oxygenase (MFO) activities were enhanced (+ 129% for aminopyrene N demethylase and + 88% for benzopyrene monooxygenase). Epoxide hydrolase and glutathione S transferase activities were not altered. Some metabolites generated by MFO systems can bind to DNA, but the extent of this binding was not influenced by PCB treatment. These results are discussed and compared with results of published studies, and it is concluded that chemicals which induce hydroxylase activities in fish may not necessarily influence the overall toxicity of hydrocarbons or related chemicals. (Doria-PTT)
W87-06029

UPTAKE OF POLYCHLORINATED BIPHENYLS (PCBS) BY THE MACROALGA, CLADOPHORA GLOMERATA,
Lund Univ. (Sweden). Dept. of Ecology.
P. Larsson.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 1, p 58-62, January 1987. 1 fig, 1 tab, 18 ref.

Descriptors: *Polychlorinated biphenyls, *Cladophora, *Path of pollutants, *Macroalgae, *Chlorophyta, *Bioaccumulation, Algae, Accumulation, Algal growth, Metabolism, Sediments, Ponds, Food chains, Plant physiology.

PCB levels in Cladophora glomerata were followed for two growing seasons in a model system to determine whether PCBs in sediment are avail-

able for uptake by macroalgae. The alga was grown in a large outdoor pool to which was added five to six tons of lake sediment contaminated by an industrial mixture of PCBs containing 50 to 70 individual compounds. It was found that PCBs released from the sediment (containing 2.7 micrograms/g dry weight PCBs) to the pond water were taken up by the alga. Concentrations of PCBs in the alga decreased from 3.5 micrograms/g dry weight in 1983 to 0.2 micrograms/g in August 1984. Reference samples of river algae contained 0.016 micrograms/g. Concentrations of PCBs in the water principally determined levels in the algae. Cladophora is common in Northern European and North American waters, and is often a nuisance. The rapid uptake and accumulation of PCBs by the alga suggests that even short exposure to PCBs may result in a considerable pool stored in Cladophora. This pool may be transferred to grazing fish or contaminate the detritivoral food chain. It is concluded that filamentous algae may serve as a residual compartment for PCBs, making them available for organisms. (Doria-PTT)
W87-06030

MODEL ECOSYSTEM DETERMINATION OF THE METABOLIC AND ENVIRONMENTAL FATE OF TETRACHLORO-DDT,
Illinois Univ. at Urbana-Champaign. Dept. of Chemistry.
R. B. Cole, and R. L. Metcalf.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 1, p 96-103, January 1987. 2 fig, 5 tab, 14 ref.

Descriptors: *Fate of pollutants, *Metabolism, *DDT, *Model studies, Ecosystems, Bioaccumulation, Accumulation, Biological magnification, Chemical analysis, Pesticides, Organic compounds, Degradation, Water analysis, Chemistry, Path of pollutants.

A Metcalf model ecosystem was used to investigate the environmental and metabolic fate of tetrachloro-DDT, a precursor in pesticide manufacturing. DDE was found to be the major metabolite and the ultimate recalcitrant degradative product of tetrachloro-DDT. The parent compound was not detected in any of the organism or water extracts. The mechanism of DDE formation is discussed. Other degradation products included polar metabolites (e.g., dicofol) and a low-polarity compound that may be a metabolite of a non-polar impurity present in the original parent compound. Calculations of ecological magnification indices are presented. It is concluded the nature and extent of environmental contamination by tetrachloro-DDT is similar to that of DDT contamination, since the major environmentally persistent product of degradation for the two compounds is the same. (Doria-PTT)
W87-06034

RELATIONSHIP BETWEEN CHRONIC TOXICITY AND BIOACCUMULATION OF COPPER, CADMIUM AND ZINC AS AFFECTED BY WATER HARDNESS AND HUMIC ACID,
Miami Univ., Oxford, OH. Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W87-06043

INCREASED AVAILABILITY OF CADMIUM TO PERFUSED RAINBOW TROUT (SALMO GAIRDNERI, RICH.) GILLS IN THE PRESENCE OF THE COMPLEXING AGENTS DIETHYL DITHIOCARBAMATE, ETHYL XANTHATE AND ISOPROPYL XANTHATE,
Uppsala Univ. (Sweden). Dept. of Zoophysiology.
For primary bibliographic entry see Field 5C.
W87-06049

TOXICOKINETIC MODELING OF (14C)PENTACHLOROPHENOL IN THE RAINBOW TROUT (SALMO GAIRDNERI),
Environmental Research Lab.-Duluth, MN.
J. M. McKim, P. K. Schmieder, and R. J. Erickson.
Aquatic Toxicology AQTODG, Vol. 9, No. 1, p 59-80, October 1986. 5 fig, 7 tab, 36 ref.

Descriptors: *Path of pollutants, *Bioaccumulation, *Isotope studies, *Model studies, *Fish, *Trout, *Pentachlorophenol, *Radioactive tracers, *Toxicokinetics, *Tracers, Pollutants, Kinetics, Toxicity, Fish toxins, Sublethal effects, Behavior, Fish behavior, Biological magnification, Radioactive halflife, Metabolites.

An in vivo trout model was used to monitor the major routes and rates of pentachlorophenol uptake and elimination. Rainbow trout exposed to a mean sublethal water concentration (1.0 micrograms/l) of (14C)pentachlorophenol (PCP) acquired a mean calculated dose of 230 micrograms/kilogram per 48 hours and a mean measured dose of 212 micrograms/kilogram per 48 hours. The rate constants determined for the calculated and measured doses were found to be in close agreement which provided further support for the use of this model system in aquatic toxicokinetic studies. A first-order kinetic model and observed data were used to generate fitted and predicted rate constants required for evaluation of first-order kinetics. The fitted first-order uptake-depuration curves for all experimental animals agreed with those observed suggesting first-order kinetics approximated the behavior of whole-body PCP burden; differences were due to the low predicted value used in the model for the steady-state PCP bioconcentration factor (BCF). A BCF of 460 was estimated from the first order simulation model developed from empirical data collected on uptake and elimination of PCP. The dosing time required to reach this steady-state BCF was 280 hours. The estimated half-life was 65 hours with approximately 50% eliminated over the gills, 30% in the feces and bile, and 20% in the urine. A depuration period of 280 hours was required to eliminate 95% of the steady-state concentration of PCP. Approximately 43% of the 48-hour dose of (14C)PCP remained in the major organs and muscle tissues of these trout at the end of the 96-hour experiment. Of this amount, muscle contained 29% of the total remaining (14C)PCP equivalents while the remaining carcass contained 45%. The PCP radiocarbon excreted in the urine was 10% PCP and 90% 'other' (metabolite/conjugate), while the bile was 45% PCP and 55% 'other'. PCP and its metabolites were rapidly eliminated from the bodies of fish, which provided for a low BCF. Efficient elimination of PCP should allow vertebrates to tolerate periodic low doses of PCP without toxic effects. (Author's abstract)
W87-06053

CYTOCHEMICAL LOCALIZATION OF TIN IN FRESHWATER MUSSELS EXPOSED TO DI-N-BUTYLTIN DICHLORIDE,
Utrecht Rijksuniversiteit (Netherlands). Lab. of Chemical Animal Physiology.
For primary bibliographic entry see Field 5C.
W87-06055

ORGANIC COPPER AND CHROMIUM COMPLEXES IN THE INTERSTITIAL WATERS OF NARRAGANSETT BAY SEDIMENTS,
Rhode Island Univ., Narragansett. Graduate School of Oceanography.
For primary bibliographic entry see Field 5A.
W87-06056

TRACE METAL SEASONAL VARIATIONS IN TEXAS MARINE SEDIMENTS,
Geological Survey, Denver, CO.
C. W. Holmes.
Marine Chemistry MRCHBD, Vol. 20, No. 1, p 13-27, October 1986. 10 fig, 27 ref.

Descriptors: *Path of pollutants, *Winds, *Sediments, *Trace metals, *Coastal waters, *Sediment-water interfaces, *Seasonal variation, *Marine sediments, Coasts, Sediment load, Shores, Coastal zone management, Sediment distribution, Texas, Harbors, Corpus Christi, Oxygen depletion, Metals, Geochemistry, Sediment transport, Water temperature.

Trace elements in coastal environments are derived from three major sources: (1) the bordering watershed; (2) the offshore marine environment; and (3) industrial and/or urban effluent. The site of deposition, however, is controlled by physical and chemical processes in the coastal zone. In many cases, these processes are controlled by climate and can vary seasonally. In the harbor at Corpus Christi, Texas, the summer climate creates an oxygen-poor environment in the water column near the sediment-water interface. This causes chalcophilic metals to precipitate from the water, resulting in high concentrations in the sediments near the source. During the winter, turbulence created by strong winds causes the entire mass to become aerated and oxidizing, and remobilization of some of the metals results. In addition, this turbulence accelerates circulation which transports the metal-enriched waters from the harbor. On the outer continental shelf of south Texas, the infaunal activity affects the chemical environment within the sediment near the sediment-water interface; the observed trace metal content at the interface also appears to change with the seasons. (Author's abstract)
W87-06059

TRACE METAL TRANSPORT IN TWO TRIBUTARIES OF THE UPPER CHESAPEAKE BAY: THE SUSQUEHANNA AND BUSH RIVERS,
Florida Univ., Gainesville. Dept. of Environmental Engineering.
J. D. Delfino, and R. G. Otto.
Marine Chemistry MRCHBD, Vol. 20, No. 1, p 29-44, October 1986. 5 fig, 1 tab, 31 ref.

Descriptors: *Path of pollutants, *Trace metals, *Heavy metals, *Tributaries, *Rivers, *Susquehanna River, *Bush River, Metals, Metal transport, Iron, Manganese, Zinc, Copper, Susquehanna River, Bush River, Chesapeake Bay, Seasonal variations, Snowmelt, Runoff, Hydrologic cycle, Sediments, Suspended solids.

A study of Fe, Mn, Zn, and Cu transport in two tributaries of the Upper Chesapeake Bay (the Susquehanna and Bush Rivers) was performed. Sampling was conducted according to hydrologic seasons. Three phases (soluble (< 0.2 micron), fine (> 0.2 micron, < 3 micron) and coarse particulates (> 3 micron)) of each metal were separated by rapid filtration and then analyzed. Particulate Fe was the major Fe phase in both rivers during all seasons. Soluble Mn was the dominant Mn phase in winter in both rivers and also during fall and snowmelt-runoff period in the Susquehanna River and summer at one Bush River station. Soluble Zn was the principal Zn phase in winter in both rivers and also in summer in the Susquehanna River, while particulate Zn was dominant during the remaining seasons. Copper showed the greatest prevalence in the soluble phase among the four metals studied. The soluble phase was the major form of Cu during fall, winter and spring in both rivers and also in summer in the Susquehanna River. The trace metal phase distributions were related to seasonal hydrologic conditions and water chemical phenomena, such as the release of Mn from anoxic sediments. The metal content of total suspended matter in the rivers was at least the same order of magnitude as seen for other world rivers, although the Fe and Mn contents in the total suspended matter were enriched above the world averages on some sampling dates in both the Susquehanna and Bush Rivers. The content of all four metals in the total suspended matter was greater than would be predicted based on the weathering of exposed suficial rock, indicating the contribution of anthropogenic sources to the particulate metal content of both rivers. (Author's abstract)
W87-06060

PETROLEUM HYDROCARBONS IN THE MEDITERRANEAN SEA: A MASS BALANCE,
Bermuda Biological Station for Research, St. George's West.
K. A. Burns, and A. Saliot.
Marine Chemistry MRCHBD, Vol. 20, No. 2, p 141-157, November 1986. 4 tab, 72 ref.

Descriptors: *Petroleum products, *Hydrocarbons, *Path of pollutants, *Oil pollution, *Mediterranean

Sea, *Seawater, *Model studies, *Mass balance model, Oil, Pollutants, Water pollution, Data interpretation, Geochemistry, Organic wastes, Organic compounds, Ecosystems, Model studies, Input-output analysis, Mass balance model, Pollution load.

Over three quarters of a million tons of oil were estimated to be introduced annually into the Mediterranean Sea from land-based and open-sea discharges. A critical assessment was made of available data through 1983 on the distribution of petroleum-derived hydrocarbon residues and the biogeochemical processes controlling the transport and fate of organic contaminants in this regional sea ecosystem. Inputs, outputs and ecosystem partitioning or inventories are computed and a complete mass balance model is proposed. The approach raises several implications with respect to strategies for the sampling and analysis of organic contaminants in ocean ecosystems. A basis on which to evaluate the effectiveness of recent discharge regulations in reducing pollution loads in the Mediterranean is provided. The agreement between calculated fluxes, inventories and input time scales demonstrates the usefulness of organic contaminants as markers for the development of global and ocean flux models. (Author's abstract)
W87-06064

DIURNAL VARIATIONS IN THE CHEMICAL ENVIRONMENT OF A SHALLOW TIDAL INLET, GULF ST VINCENT, SOUTH AUSTRALIA: IMPLICATIONS FOR WATER QUALITY AND TRACE METAL MIGRATION,
Adelaide Univ. (Australia). Dept. of Geology.
P. Harbison.
Marine Environmental Research MERSDW, Vol. 20, No. 3, p 161-195, 1986. 11 fig, 3 tab, 48 ref.

Descriptors: *Path of pollutants, *Trace metals, *Water quality, *Chemical properties, *Tidal effects, *Diurnal distribution, *Tidewater, *Gulfs, *Sediments, *Solar radiation, Tides, Pollutants, South Australian Gulf, Hydrogen ion concentration, Dissolved oxygen, Chemical composition, Tidal flats, Seawater, Alkalinity, Organic carbon, Benthic environment, Barker Inlet.

During 'dodge' tide phases in South Australian Gulf waters, there is negligible movement of water overlying the sediments of sheltered tidal inlets for up to 24 hours, and extreme fluctuations in redox potential, pH, dissolved oxygen and H2S levels occur. During normal tidal phases, water ebbing from the tidal flats early in the morning has a lower pH, redox potential and dissolved oxygen content than inflowing sea water, and sometimes a high content of H2S. Variations in dissolved metals, carbonate alkalinity and dissolved organic carbon have also been recorded. Field and laboratory observations demonstrate the dominant influence of solar irradiance on these parameters, and also the importance of water residence time, sediment characteristics and the density of benthic organisms. Implications for water quality, metal enrichment and the release of trace metals and nutrients from sediments are proposed for Barker Inlet, where waste water discharges into a shallow, sheltered environment. (Author's abstract)
W87-06065

ACCUMULATION OF CR(III) BY BACTERIA ISOLATED FROM POLLUTED SEDIMENT,
Otago Univ., Dunedin (New Zealand). Dept. of Microbiology.
J. Aislabie, and M. W. Loutit.
Marine Environmental Research MERSDW, Vol. 20, No. 3, p 221-232, 1986. 5 fig, 4 tab, 24 ref.

Descriptors: *Path of pollutants, *Chromium, *Bacteria, *Sediments, *Bioaccumulation, Pollutants, Accumulation, Aerobic bacteria, Heterotrophic bacteria, Polymers, Polysaccharides, Food chains, Sawyers Bay.

Aerobic heterotrophic bacteria isolated from a Cr polluted sediment from Sawyers Bay are able to accumulate Cr(III). Much of the Cr is accumulated in the extracellular polymer material of the cells and is associated with the polysaccharide fraction of this material. The binding of Cr to this extracellular material is a mechanism of tolerance to Cr and may facilitate Cr entry to the food chain. (Author's abstract)
W87-06067

EXCRETION OF HEAVY METALS BY THE SALT MARSH CORD GRASS, SPARTINA ALTERNIFLORA, AND SPARTINA'S ROLE IN MERCURY CYCLING,
Rutgers - The State Univ., Piscataway, NJ. Dept. of Ecology.
M. L. Kraus, P. Weis, and J. H. Crow.
Marine Environmental Research MERSDW, Vol. 20, No. 4, p 307-316, 1986. 3 tab, 27 ref.

Descriptors: *Path of pollutants, *Grasses, *Marsh plants, *Heavy metals, *Salt marshes, *Mercury, Wetlands, Aquatic plants, Industrial wastes, Leaves, Salts, Soil contamination, Field tests, Cadmium, Zinc, Piles Creek, Linden, Big Sheepshead Creek, Tuckerton, New Jersey.

Excreted salts and leaves from the Salt Marsh Cordgrass Spartina alterniflora were collected from two different sites. One site, Piles Creek (PC), is near heavily industrialized Linden, NJ. The other site, Big Sheepshead Creek (BSC), is located near non-industrialized Tuckerton, NJ. PC soil concentrations of mercury were 18.17 plus or minus 7.67 ppm, while BSC soil concentrations were 0.22 plus or minus 0.04 ppm. Spartina leaves from PC contained 0.16 plus or minus 0.07 ppm of mercury, and BSC leaves contained 0.02 plus or minus 0.0 ppm. Laboratory studies showed that S. alterniflora from both sites was capable of excreting mercury. Field collected salts from PC Spartina plants contained 0.11 plus or minus 0.02 ppm of mercury, 2.60 plus or minus 0.52 ppm of cadmium and 11.98 plus or minus 0.94 ppm of zinc. These levels of heavy metals were as much as five-and-a-half times the concentrations of these metals found in ambient sea salts. (Author's abstract)
W87-06069

PROTECTION OF GROUNDWATER BY IMMOBILIZATION OF HEAVY METALS IN INDUSTRIAL WASTE IMPACTED SOIL SYSTEMS,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 5E.
W87-06079

RELATIONSHIP BETWEEN CHEMICALLY DETERMINED AND BIOLOGICALLY AVAILABLE FORMS OF PHOSPHORUS IN LAKES AND STREAMS,
Rutgers - The State Univ., New Brunswick, NJ. Center for Coastal and Environmental Studies.
For primary bibliographic entry see Field 5C.
W87-06085

CHARACTERIZATION OF A LANDFILL-DERIVED CONTAMINANT PLUME IN GLACIAL AND BEDROCK AQUIFERS, NE ILLINOIS,
Northern Illinois Univ., De Kalb. Dept. of Geology.
C. J. Booth, and P. J. Vagt.
Available from the National Technical Information Service, Springfield, VA 22161 as PB87 131736/AS, Price codes: A05 in paper copy, A01 in microfiche. Illinois Water Resources Center, Urbana-Champaign, UIUC-WRC-86-202, WRC Research Report 202, July 1986. 93 p, 21 fig, 12 tab, 39 ref. Contract No. 14-08-0001-1015, Project No. USGS G1015-05.

Descriptors: *Sanitary landfills, *Groundwater pollution, Groundwater hydrology, Organic compounds, Glacial aquifers, Illinois, Blackwell landfill, Water pollution sources, Bedrock, Path of pollutants, Inorganic compounds.

Groundwater contamination by organic and inorganic chemicals is a regional and national problem; landfills are major potential contaminant sources. In this study of the Blackwell landfill, DuPage County, Illinois the contaminant plume is delineated and related to the site history and hydrogeology. Leachate leakage is attributed partly to landfill construction problems. The landfill is located partly on a sand-and-gravel aquifer and partly on thick, poorly permeable till, all overlying an important dolomite aquifer. A roughly concentric contaminant plume surrounds the landfill in the glacial materials. A leachate leakage rate of between 600 and 3000 cu ft/day was estimated from infiltration and leachate-level calculations. The leakage is rapidly diluted in the aquifer; background TDS levels are reached on site. Volatile organics have concentrations of over 100 ppb in the aquifer close to the landfill, but decrease rapidly away. The contaminant plume appears to have reached equilibrium, and does not extend off site. The bedrock is probably in continuity with the glacial aquifer; however, the traces of organics found therein are not clearly linked to the landfill plume and may originate from other sources. This study has generated considerable field data which should be valuable in future studies. (Stout-ILWRC)
W87-06095

URBAN STORM RUNOFF IN HAWAII,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
R. H. F. Young.
IN: Collected Reprints, Volume V: 1978-1981, June 1984. Water Resources Research Center, Honolulu, Hawaii. p 53-58, 1 fig, 3 tab, 17 ref.

Descriptors: *Storm runoff, *Urban runoff, *Water quality control, *Water pollution control, *Storm sewers, Urban drainage, Runoff, Water pollution prevention, Heavy metals, Pathogenic bacteria, Water quality, Monitoring.

Urban stormwater pollution in Hawaii has been studied seriously only for the past few years to determine the effect of stormwater or streamflows on coastal water quality. Early studies conducted by the Water Resources Research Center are of limited use in determining total emission due to the sparseness of accompanying flow data. These attempts include stream surveys and collection and analysis of street sweepings that help to identify and define the quality problem of urban storm runoff. More recently published studies include stream surveys from which pollutant loading rates have been calculated, street sweepings collections from which contaminant loads per length of curbing have been determined, and data from runoff in storm sewers. Results thus far show that the contamination potential for receiving waters is greatest due to suspended solids, heavy metals, and possibly bacterial pathogens. (See also W87-06103) (Geiger-PTT)
W87-06106

MECHANISMS OF POLIOVIRUS INACTIVATION BY HYPOCHLOROUS ACID,
Hawaii Univ., Honolulu. Dept. of Microbiology.
For primary bibliographic entry see Field 5D.
W87-06118

MECHANISM OF CHLORAMINE INACTIVATION OF POLIOVIRUS: A CONCERN FOR REGULATORS,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
R. S. Fujioka, K. Tenno, and P. C. Loh.
IN: Collected Reprints, Volume V: 1978-1981, June 1984. Water Resources Research Center, Honolulu, Hawaii. p 341-345, 4 fig, 1 tab, 11 ref.

Descriptors: *Viruses, *Enteric viruses, *Disinfection, *Chloramines, *Water treatment, Chlorination, Chlorine, Proteins, Nucleic acids, Public health, Infection, Microbiological studies, Fate of pollutants.

The mechanism of poliovirus inactivation by chloramines formed in a sewage effluent was examined and the potential health significance of viruses inactivated by HOCl vs chloramines was evaluated. Chloramine inactivation of poliovirus was dose-dependent. Inorganic chloramines inactivated more viruses than organic chloramines.

HOCl was more effective than chloramines in inactivating poliovirus; however, both disinfectants inactivated the virus by disrupting the protein coat. Both chloramine and HOCl inactivated the poliovirus before structural degradation of the virus was detected by sedimentation and buoyant density analysis and by examination of physical properties by electron microscopy. Both disinfectants did not affect the viral RNA as evidenced by the recovery of infectious RNA from poliovirus determined to be inactivated by either HOCl or chloramines. (See also W87-06124) (Geiger-PTT)
W87-06124

SPATIAL AND TEMPORAL DISTRIBUTION OF CHEMICAL SUBSTANCES IN LAKES: MODELING CONCEPTS,
Eidgenoeassische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
D. M. Imboden, and R. P. Schwarzenbach.
IN: Chemical Processes in Lakes, John Wiley and Sons, New York, New York. 1985. p 1-30, 8 fig, 7 tab, 23 ref.

Descriptors: *Path of pollutants, *Lakes, *Model studies, Ecosystems, Water pollution effects, Fate of pollutants, Mathematical studies, Mathematical equations, Mixing, Spatial distribution, Temporal distribution.

The understanding of the dynamic behavior of chemical species in a given aquatic ecosystem is a prerequisite for the risk and hazard assessment of chemical pollution. Modeling concepts are provided to evaluate the relative importance of reaction processes (i.e., chemical and biological reactions, water-air exchange, and interactions between the dissolved and particulate phases) versus transport phenomena (i.e., water flow and mixing), and their impact on the distribution and residence time of pollutants in lakes. A one-dimensional vertical mixing model which includes the topography of the lake is discussed by using hydrophobic organic compounds as an example. Hydrophobic organic compounds served as an example to demonstrate the usefulness of this model to explain the vertical distribution of such species in lakes. Only very scarce field data are available to validate such model calculations. Therefore, it is often difficult to describe and quantify properly compound-specific processes such as sorption/desorption, reactions on solids, and biologically mediated transformations. On the lake-specific side, open questions refer mainly to the phenomena which deal with the dynamics of particles and the interaction between sediments and water (particle formation, sedimentation, resuspension, etc). Nevertheless, conceptual models as presented here are indispensable tools to assess the dynamic behavior of chemicals in the aquatic environment. They not only serve to predict concentration levels in lakes resulting from a given loading, but the model calculations - if compared to field data - can also be used to identify and even quantify yet unknown sources or reaction pathways. (See also W87-06126) (Lantz-PTT)
W87-06127

CONCEPTUAL MODELS FOR TRANSPORT AT A REDOX BOUNDARY,
Freshwater Biological Association, Ambleside (England).
For primary bibliographic entry see Field 2K.
W87-06128

AQUEOUS SURFACE CHEMISTRY: ASSESSMENT OF ADSORPTION CHARACTERISTICS OF ORGANIC SOLUTES BY ELECTROCHEMICAL METHODS,
Institut Rudjer Boskovic, Zagreb (Yugoslavia). Center for Marine Research.
For primary bibliographic entry see Field 7B.
W87-06129

REDOX-RELATED GEOCHEMISTRY IN LAKES: ALKALI METALS, ALKALINE-EARTH ELEMENTS, AND 137-CS,
Woods Hole Oceanographic Institution, MA.
For primary bibliographic entry see Field 2H.
W87-06132

MECHANISMS CONTROLLING THE SEDIMENTATION SEQUENCE OF VARIOUS ELEMENTS IN PREALPINE LAKES,
Konstanz Univ. (Germany, F.R.). Limnological Inst.
For primary bibliographic entry see Field 2J.
W87-06133

PAVIN CRATER LAKE,
Ecole Normale Superieure, Paris (France). Lab. de Geologie.
For primary bibliographic entry see Field 2H.
W87-06134

INFLUENCE OF COAGULATION AND SEDIMENTATION ON THE FATE OF PARTICLES, ASSOCIATED POLLUTANTS, AND NUTRIENTS IN LAKES,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
C. R. O'Melia.
IN: Chemical Processes in Lakes, John Wiley and Sons, New York, New York. 1985. p 207-224, 6 fig, 5 tab, 10 ref. NSF Grant CEE81-21501.

Descriptors: *Fate of pollutants, *Path of pollutants, *Sedimentation, *Lakes, *Nutrients, Particles, Fate of pollutants, Lake sediments, Chemical properties, Depth, Viscosity, Temperature, Water density, Suspended sediments.

Some solid particles are present in all lakes. Pollutants and nutrients are associated with these particles. Collisions between these particles create aggregates,a dn both the particles and their aggregates are subject to sedimentation. Examined are the effects of some physical factors (mean depth, temperature, viscosity, water density, particle density, velocity gradient, areal hydraulic loading, coagulation efficiency, and particle concentration in river inflow) on the origins and effects of coagulation and sedimentation in lakes. The influence of selected chemical factors (colloidal stability, kinetics, sorption) on the transport and fate by these processes of solid particles and associated substances in lakes was studied. The results indicate that coagulation can be sufficiently rapid and extensive to affect water quality in lakes significantly. Coagulation can also affect the transport of many pollutants and nutrients. (See W87-06126) (Lantz-PTT)
W87-06136

COUPLING OF ELEMENTAL CYCLES BY ORGANISMS: EVIDENCE FROM WHOLE-LAKE CHEMICAL PERTURBATIONS,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 2H.
W87-06137

GEOBIOLOGICAL CYCLE OF TRACE ELEMENTS IN AQUATIC SYSTEMS: REDFIELD REVISITED,
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab. for Water Resources and Hydrodynamics.
F. M. M. Morel, and R. J. M. Hudson.
IN: Chemical Processes in Lakes, John Wiley and Sons, New York, New York. 1985. p 251-281, 5 fig, 5 tab, 63 ref, append. NOAA Grant No. NA79AA-D-00077 and NSF Grant No. OCE-8119103.

Descriptors: *Path of pollutants, *Trace elements, *Model studies, *Geobiology, *Chemical processes, *Seawater, Algae, Water columns, Particulate matter, Copper, Calcium, Magnesium.

Because of their isolation from allochthonous sources, the open oceans provide a convenient model system in which to examine the role of the biota in element cycles. An attempt is made here to obtain a general picture of trace-element geobiology by weaving together field data on the soluble and particulate metal concentrations in the oceanic water column, laboratory information on metal uptake by algae, and teleological reasoning. It is argued that many major and trace elements, essential and toxic, may be simultaneously controlling biological production in the oceans, and that, in turn, the cycle of these elements is controlled by the biota. A condition at the thresholds of limitation by essential elements and of toxicity by their chemical analogs is seen as the normal result of evolution in a stable environment. Conversely, the composition of the water reflects the affinity of the organisms for the various elements, such affinity controlling the partitioning into the particulate phase and the transport to the sediments. Neither the inorganic nor the organic analogs of marine particulate matter considered here have a sufficient affinity for trace metals, with the possible exception of copper, to account for the adsorption onto particles required by the scavenging residence times for the metals. This difference from previous conclusions is the consequence of a more complete consideration of competition for metal binding sites from calcium, magnesium, and hydrogen ions in seawater and as comparison of observations and calculations for each metal rather than correlations fit to many elements. Thus, there must be some other solid(s) with higher affinities for metals that is responsible for scavenging in the deep ocean. (See also W87-06126) (Lantz-PTT)
W87-06138

METAL TRANSFER MECHANISMS IN LAKES; THE ROLE OF SETTLING PARTICLES,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
L. Sigg.
IN: Chemical Processes in Lakes, John Wiley and Sons, New York, New York. 1985. p 283-310, 9 fig, 7 tab, 45 ref.

Descriptors: *Path of pollutants, *Heavy metals, *Particulate matter, *Lake Constance, *Lake Zurich, Trace metals, Carbon, Nitrogen, Phosphorus, Silicon, Copper, Zinc, Lead, Cadmium.

Settling particles, especially biogenic organic particles, play a dominating role in binding heavy metals and transferring them into the sediments, thereby regulating the concentrations of dissolved metals in lakes. As shown by investigations in Lake Constance and in Lake Zurich, lakes, despite being much more polluted with heavy-metal ions, are nearly as much depleted in these trace-metal concentrations as are the oceans. Larger productivities and higher particle sedimentation rates are primarily responsisble for the more efficient scavenging. The partition of the heavy metals between the particles and the water, is influenced by the affinity of the metal for the particle surface and the chemical speciation of the metal in solution. In the lakes investigated a large part of the settling particles consists of phytoplankton and biological debris. The mean elemental composition of these particles corresponds within broad margins to a reasonably constant stoichiometry of C-113, N-15, P-I, Si-14, Cu sub 0.008, Zn sub 0.06, Pb sub 0.004, and Cd sub 0.00005. Another scavenging and metals regeneration cycle operates in the deeper water layers. Mn(II) and Fe(II) are released from the sediments to the overlying water where they become oxidized to oxides of Mn (III, IV) and Fe(III) which are potential carrier phases of heavy metals. (See also W87-06126) (Author's absract)
W87-06139

ACIDIFICATION OF AQUATIC AND TERRESTRIAL SYSTEMS,
Iowa Univ., Iowa City. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5C.
W87-06140

CHEMISTRY OF BOG WATERS,
Minnesota Univ., Minneapolis.
For primary bibliographic entry see Field 2H.
W87-06141

GROUNDWATER CONTAMINATION PROBLEM AND RELATED RESEARCH,
Texas Univ. at Austin. Biomedical Engineering Lab.
For primary bibliographic entry see Field 5C.
W87-06156

FACTORS INFLUENCING THE FORMATION OF POTENTIAL ACIDITY IN TIDAL SWAMPS,
Agricultural Univ., Wageningen (Netherlands). Dept. of Soil Science and Geology.
For primary bibliographic entry see Field 2L.
W87-06165

SOIL SURVEY OF TIDAL SULPHIDIC SOILS IN THE TROPICS: A CASE STUDY,
Land Resources Development Centre, Surbiton (England).
For primary bibliographic entry see Field 2G.
W87-06166

QUANTITATIVE MODELS TO PREDICT THE RATE AND SEVERITY OF ACID SULPHATE DEVELOPMENT: A CASE STUDY IN THE GAMBIA,
University of East Anglia, Norwich (England). School of Environmental Sciences.
For primary bibliographic entry see Field 2G.
W87-06167

ROCK PHOSPHATE IN RICE PRODUCTION ON ACID SULPHATE SOILS IN VIETNAM,
Can Tho Coll. (Vietnam). Faculty of Agriculture.
For primary bibliographic entry see Field 5G.
W87-06173

WATER, SOIL AND RICE IN AN ACID SULFATE SOIL OF THAILAND,
Tokyo Univ. (Japan). Faculty of Agriculture.
For primary bibliographic entry see Field 2G.
W87-06182

PHOSPHATE DYNAMICS IN AN ACID SULFATE SOIL UNDER FLOODED CONDITION STUDIED BY A TRACER TECHNIQUE,
Royal Statistical Society, London (England).
A. K. Alva, and S. Larsen.
IN: Proceedings of the Bangkok Symposium on Acid Sulphate Soils, Second International Symposium on Acid Sulphate Soils, Bangkok, Thailand, January 18-24, 1981. ILRI Publication 31, 1982. p 368-380, 4 tab, 23 ref.

Descriptors: *Phosphates, *Acidic soils, *Flood irrigation, *Path of pollutants, *Tracers, *Thailand, Nitrogen, Soil water, Plant growth, Phosphorus, Potassium.

Tracer techniques are efficient for studying P dynamics in flooded acid sulfate soil planted in rice. This study deals with changes in labile P in an acid sulfate soil from the Central Plain of Thailand. Available P was estimated at different times during the rice growing period by determining isotopic dilution of P absorbed by plants (L-value) and also by isotopic exchange in the soil (E-value). The influence of varying levels of applied N, P and K on labile P and the recovery of applied P were examined in a growth chamber. During the growth period L-values for rice increased the first 80 days after transplanting and subsequently decreased toward crop maturity, as a result of crop-induced P mobilization followed by immobilization. The influence of rice cropping on labile P was appreciable 50 days after transplanting. Delta-L-values and recovery of applied P, at a uniform rate of P application, increased with increasing N and K enrichment. At a given level of N and K accompanied by a low P application the recovery of applied P remained constant during the major part of the growing period, while at high application of P recovery decreased over the growing period. The influences of mineral nutrition on P dynamics are discussed. E-values were considerably higher than the L-values at the crop maturity stage. The possible causes for this discrepancy are discussed. (See also W87-06162) (Lantz-PTT)
W87-06185

POLLUTANTS AND THEIR ECOTOXICOLOGICAL SIGNIFICANCE.
For primary bibliographic entry see Field 5C.
W87-06187

BASIC ECOLOGICAL PARAMETERS, MONITORING AND BIOLOGICAL MONITORS IN THE AQUATIC ENVIRONMENT,
Barcelona Univ. (Spain). Facultat de Biologia.
R. Margalef.
IN: Pollutants and Their Ecotoxicological Significance, John Wiley and Sons, Chichester, England, 1985. p 149-175, 9 fig, 1 tab, 8 ref.

Descriptors: *Water pollution effects, *Ecological distribution, *Monitoring, *Path of pollutants, *Aquatic environment, *Environmental effects, *Bioindicators, Radioisotopes, Heavy metals, Organic compounds, Eutrophication, Water pollution effects.

Organisms are very sensitive indicators and are convenient for putting together historical sequences of events, but it is inadvisable to rely on them very much because of frequent mistaken identification, incomplete lists and inadequate knowledge of their requirements. The variables used for monitoring rarely coincide with those preferred by ecologists, which are based on more elaborate levels of conceptualization. It seems more constructive to compare networks of interrelated variables at different levels than to look for one-to-one correspondences. Precise definition of the values of variables related to public or legal action (tolerated maxima, thresholds) is approached with reluctance on the part of ecologists since single variables are never a fair expression of the state of an ecosystem. Practical problems involve situations that usually fall into one of two classes: (a) the flow and eventual accumulation of specific pollutants (radioactive isotopes, heavy metals, organic substances) along the normal pathways of an ecosystem that has not changed very much, and (b) generalized phenomena, such as eutrophication, in which an ecosystem is force-fed, a state accompanied by an acceleration in its internal cycles and the development of external loops that remove, at least temporarily, some of the materials. (See also W87-06187) (Lantz-PTT)
W87-06188

SOME SELECTED EXAMPLES OF EUTROPHICATED EUROPEAN LAKES,
Commission of the European Communities, Ispra (Italy). Joint Research Centre.
For primary bibliographic entry see Field 2H.
W87-06189

REGIONAL CASE STUDY OF THE POLLUTION OF NATURAL WATERS, SOILS AND PLANTS BY LEAD, CADMIUM AND ZINC,
Paris-7 Univ. (France). Lab. de Chimie Minerale des Milieux Naturels.
J. Faucherre, A. M. Pinart, J. Pinart, and A. Dutot.
IN: Pollutants and Their Ecotoxicological Significance, John Wiley and Sons, Chichester, England, 1985. p 189-204, 5 fig, 8 tab, 10 ref.

Descriptors: *Path of pollutants, *Water pollution effects, *Lead, *Cadmium, *Zinc, Industrial wastes, Pyrites, Acidic water, Mine wastes, Trees.

Pollution of the river run-off from mine workings has two sources: the open-cast mine during dry weather and the slag-heap during wet periods. These two sources cause pollution by different processes: (a) Pb, Zn and Cd pollution from surface mining, due mainly to the oxidation of pyrites and the resultant acidification (pH=2) of the waters; (b) Pb, Zn and Cd pollution from the slag-heap. Sands from this source, rich in pyrites, are physically transported by the river during wet periods and are deposited on the soil of meadows and vegetable plots with thicknesses of up to 20-cm. The extent of contamination of commonly consumed plants by Pb, Zn and Cd were studied. The first mechanism (pollution from surface mining) leads to only a small amount of Pb pollution in plants (2 to 3 times the permissible limits set by the World Health Organization), whereas pollution by the second mechanism (physical pollution from the slag-heap) is much more significant (2 to 16 times the WHO limits). Zinc and cadmium concentrations in the annual growth rings of conifers are good chronological tracers of pollution in water courses. Changes in mining activity and the background value of Zn and Cd which indicates anthropogenic pollution can be roughly reconstructed. On the other hand, Pb cannot be used as a tracer; it can be used as such to detect atmospheric pollution close to main roads, but only in a very limited way. The effects of pollution of commonly consumed plants can be reflected by birth rate, and is also an aspect of pollution examined here. From 1926 to 1968, the number of children per family, about 2 on the national scale, is 2.1 for a non-polluted community. It falls to 1.1 for a community irrigated by a river polluted with Pb and Cd. (Lantz-PTT)
W87-06190

TOXIC METAL LEVELS IN THE RIVER RHINE,
Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Angewandte Physikalische Chemie.
R. Breder, H. W. Nurnberg, J. Golimowski, and M. Stoeppler.
IN: Pollutants and Their Ecotoxicological Significance, John Wiley and Sons, Chichester, England, 1985. p 205-225, 13 fig, 24 ref.

Descriptors: *Toxicity, *Heavy metals, *Rhine River, *Path of pollutants, Cadmium, Lead, Mercury, Lake Constance, Holland, Germany, River sediments, Rivers.

The levels of the heavy metals, Cd, Pb and Hg, were determined in water and sediments of the River Rhine and the main tributaries from Lake Constance to the Dutch/German border within a dense sequence of sampling stations. The anthropogenic heavy metal pollution increased downstream from Lake Constance to the Dutch/German border with some superimposed peaks. At least in one of the two years, 1977 or 1978, the highest Cd, Pb and Hg concentrations in River Rhine sediments occurred at Emmerich. The metal enrichment factors in the sediment from Emmerich in 1978 in comparison with the geochemical background levels were Cd, 48.8; Hg, 22.4; and Pb, 17.6. The sediment data revealed a downstream shift of the maxima from 1977 to 1978. It could not be ascertained that the levels decreased in general in 1978. With regard to the tributaries the Lippe, the Wupper and the Main showed a high Hg pollution of the sediments. Also in the water of the Main exceptional high total Hg concentrations up to 401 nanograms(ng)/L were observed. The background level for total Hg was about 5 ng/L. For Cd in sediments the Ruhr tributary showed a maximum in 1977 (30 mg/kg, DW), for Pb also the Lahn and Moselle (600-750 mg/kg, DW). With respect to water contents, 94.4 micrograms/L total Cd were determined in the Wupper tributary and 37.2 micrograms/L total Pb in the Erft tributary. (See also W87-06187) (Lantz-PTT)
W87-06191

ESTUARINE PROCESSES AND RIVERBORNE POLLUTANTS,
Kiel Univ (Germany, F.R.). Inst. fuer Meereskunde.
For primary bibliographic entry see Field 2L.
W87-06192

TRANSPORT, FATE AND RECYCLING OF HEAVY METALS IN SEA-WATER ECOSYSTEMS,
Vrije Univ., Brussels (Belgium). Lab. of Ecology and Systematic Botany.
I. Elskens, and L. Goeyens.
IN: Pollutants and Their Ecotoxicological Significance, John Wiley and Sons, Chichester, England, 1985. p 239-253, 5 fig, 3 tab, 16 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Heavy metals, *Saline water, *Ecosystems, North Sea, Monitoring, Zinc, Lead, Cadmium, Mercury, Copper.

Detailed are a few basic concepts of the translocation of heavy metals within the marine ecosystem of the southern part of the Southern Bight of the North Sea, particularly with regard to the choice of control parameters and the variability of the degrees of contamination observed. The advantage of a systematic approach using a mathematical model lies in considering, by definition, the elements to be monitored in the marine medium as forming part of a function whole. The problem relating to the dispersion of these concentrations is discussed. In the case of the zooplankton, it has been shown on several occasions that the distribution or dispersal of the concentrations often represents a characteristic of a given zone or group of zones. A close study of the evolution of the degree of contamination of the zoolankton (case of the Zn, Cu, Cd, Hg and Pb), shows that there are two very different kinds of seasonal evolution; the first correponds to an increase in the degree of contamination in relation to the annual mean concentration during the period(s) taken to be the high season; the second corresponds to a reduction in the concentrations in relation to the mean concentration during this same period. (See also W87-06187) (Lantz-PTT)
W87-06193

CHEMICAL POLLUTANTS IN THE MARINE ENVIRONMENT, WITH PARTICULAR REFERENCE TO THE NORTH SEA,
Kiel Univ. (Germany, F.R.). Inst. fuer Meereskunde.
For primary bibliographic entry see Field 5C.
W87-06194

ASSESSING POLLUTION IN THE MEDITERRANEAN SEA,
International Lab. of Marine Radioactivity, Monaco-Ville (Monaco).
For primary bibliographic entry see Field 5C.
W87-06195

NEW CHALLENGES TO ECOTOXICOLOGY,
Commission of the European Communities, Brussels (Belgium).
For primary bibliographic entry see Field 5G.
W87-06196

GROUNDWATER POLLUTION MICROBIOLOGY.
For primary bibliographic entry see Field 5C.
W87-06201

GROUNDWATER POLLUTION MICROBIOLOGY: THE EMERGING ISSUE,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
G. Bitton, and C. P. Gerba.
IN: Groundwater Pollution Microbiology, John Wiley and Sons, New York, New York, 1984. p 1-7, 3 tab, 11 ref.

Descriptors: *Groundwater pollution, *Microbiological studies, *Fate of pollutants, Legislation, Path of pollutants, Microorganisms, Research priorities, Bioindicators.

Within the field of aquatic microbiology, little is known about the microbiological aspects of groundwater pollution in comparison to surface waters. Some of the research needs in groundwater pollution microbiology are: (1) fate of pathogens in subsurface environment; (2) microbial activity in subsurface environment; (3) microorganisms as tracers; and (4) methodological problems. More needs to be known about the behavior of pathogens in subsurface environments, their persistence and transport in aquifer material. This research should logically lead to the selection of suitable indicator(s) of groundwater contamination with fecal wastes. Probably because it is a hidden resource, groundwater has been abused for many years. The best approach to the protection of this resource is by prevention. Various pieces of legislation have dealt more or less with groundwater protection. It is worth noting that groundwater has only been recognized as an important part of the U.S. water resources since 1974 (Safe Drinking Water Act of 1974). Legislation pertaining to groundwater pollution needs to be coordinated and a national program needs to be defined and implemented by the regulatory agencies. (See also W87-06201) (Lantz-PTT)
W87-06202

SOURCES OF GROUNDWATER POLLUTION,
Texas Univ. Medical School at Houston. Program in Infectious Diseases and Clinical Microbiology.
B. H. Keswick.
IN: Groundwater Pollution Microbiology, John Wiley and Sons, New York, New York, 1984. p 39-64, 6 fig, 8 tab, 69 ref.

Descriptors: *Groundwater pollution, *Water pollution sources, *Path of pollutants, Fate of pollutants, Microorganisms, Bacteria, Viruses, Industrial wastes, Wastewater, Injection wells, Waste dumps, Leaching.

The sources of groundwater pollutants are many and varied. Pollution by disease-causing microorgansisms occurs when human and animal wastes containing viruses, bacteria, and parasites come into contact with groundwater and can be responsible for large outbreaks of illness. Chemical pollutants can leach into groundwater from a variety of sources including hazardous waste dumps, sewage land-treatment sites, and injection wells. The myriad of chemicals that may be found in contaminated groundwater make it difficult to study their fate, transport, and health effects. Because of past, often indiscriminate, dumping of hazardous wastes, the number of cases of serious groundwater pollution is likely to increase in the near future. The cleanup of these pollution sources will be extremely expensive. (See also W87-06201) (Lantz-PTT)
W87-06204

MICROBIAL POLLUTANTS: THEIR SURVIVAL AND TRANSPORT PATTERN TO GROUNDWATER,
Arizona Univ., Tucson. Dept. of Microbiology and Immunology.
C. P. Gerba, and G. Bitton.
IN: Groundwater Pollution Microbiology, John Wiley and Sons, New York, New York, 1984. p 65-88, 3 fig, 4 tab, 123 ref.

Descriptors: *Water pollution sources, *Path of pollutants, *Groundwater pollution, *Fate of pollutants, Bacteria, Viruses, Microorganisms, Soil water, Soil temperature, Rainfall, Soil properties, Hydrogen ion concentration, Organic matter.

The persistence and transport of bacteria and viruses in the subsurface is an area of major interest to those concerned with public health. Almost half of all waterborne diseases are caused by contaminated groundwater. In order to develop adequate guidelines for the placement of waste disposal sites and drinking-water wells, information is needed on the fate of pathogenic microorganisms in groundwater. The fate of pathogenic bacteria and viruses in the subsurface is determined by their survival and retention by soil particles. Both survival and retention are largely determined by three factors nature of the soil, climate, nature of the microorganism. Climate controls two important factors in determining viral and bacterial survival: temperature and rainfall. Rainfall mobilizes previously retained bacteria and viruses and greatly promotes their transport to groundwater. Several studies have shown that the greatest degree of drinking water well contamination occurs after periods of heavy rainfall. The nature of the soil also plays a major role in determining survival and retention. Soil properties influence moisture holding capacity, pH, and organic matter. Other soil properties such as particle size, cation-exchange capacity, and clay content influence retention. Microbial resistance to environmental factors varies among different species as well as strains. Bacteria are believed to be removed largely by filtration processes while adsorption is the major factor controlling virus retention. (See also W87-06201) (Lantz-PTT)
W87-06205

MICROBIOLOGICAL PROCESSES AFFECTING CHEMICAL TRANSFORMATIONS IN GROUNDWATER,
Stanford Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2K.
W87-06206

MICROBIAL ACTIVITY IN MODEL AQUIFER SYSTEMS,
Robert S. Kerr Environmental Research Lab., Ada, OK.
For primary bibliographic entry see Field 2F.
W87-06207

HEALTH ASPECTS OF GROUNDWATER POLLUTION,
Health Effects Research Lab., Cincinnati, OH.
For primary bibliographic entry see Field 5C.
W87-06208

MICROBIOLOGICAL ASPECTS OF GROUNDWATER POLLUTION DUE TO SEPTIC TANKS,
Mississippi State Univ., Mississippi State.
C. Hagedorn.
IN: Groundwater Pollution Microbiology, John Wiley and Sons, New York, New York, 1984. p 181-195, 1 tab, 62 ref.

Descriptors: *Microbiological studies, *Groundwater pollution, *Septic tanks, *Path of pollutants, *Fate of pollutants, Domestic wastes, Bacteria, Viruses, Water pollution sources, Research priorities.

Domestic wastewaters contain bacteria, viruses, protozoa, and helminths pathogenic to humans. In addition, these infectious agents are widely distributed in many waste effluents and are commonly present in high numbers. Therefore, untreated domestic wastes embody a potential health hazard, and proper wastewater purification and disposal is an important concern. Septic-tank soil absorption treatment systems are the principal disposers of waste effluent to the soil environment. The Office of Water Supply, in a U.S. Environmental Protection Agency (EPA) report to Congress, estimated that three billion cubic meters of domestic wastewater are annually placed in soil subsurface horizons. Soil percolation of septic wastes is required for the purification of drainfield effluent before it replenishes groundwater utilized for individual and public water supply wells. However, many shallow groundwater supplies have been polluted by contaminated recharge waters. Several investigators have attributed the decline in water quality to indiscriminate use of septic tank systems in soils unsuited for adequate domestic waste purification. Bacterial modification of septic tank effluents, transport through soils, and migration from septic tank adsorption fields, and virus removal from waste effluents are discussed. Virtually all of the health-related research in water quality has been centered on fecal indicator bacteria. Efforts are needed to assess the movement potential in soil of other organisms, especially viruses, protozoan cysts, and helminth ova. Many waterborne disease outbreaks are suspected to have a viral etiology when no other causative agent can be identified, and the dynamics of viral translocation through soil may or may not resemble that of fecal bacteria. Critical examination of alternative systems or modification should include a determination of the retention efficiency of both enteric bacteria and viruses. (See also W87-06201) (Lantz-PTT)
W87-06209

LAND DISPOSAL OF SEWAGE EFFLUENTS AND RESIDUES,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
For primary bibliographic entry see Field 5E.
W87-06210

MICROORGANISMS AS GROUNDWATER TRACERS,
Arizona Univ., Tucson. Dept. of Microbiology and Immunology.
For primary bibliographic entry see Field 5A.
W87-06211

GROUNDWATER CONTAMINATION: DATA ANALYSIS AND MODELING,
Texas Univ. Health Science Center at Houston. School of Public Health.
I. Cech, and R. Harrist.
IN: Groundwater Pollution Microbiology, John Wiley and Sons, New York, New York, 1984. p 261-302, 14 fig, 7 tab, 26 ref.

Descriptors: *Groundwater pollution, *Data interpretation, *Model studies, *Path of pollutants, *Statistical analysis, Water pollution sources, Multiple regression analysis, Regression analysis, Linear regression, Analysis of variance, Bacteria, Viruses, Graphical analysis.

The use of statistics in various stages of microbiological experimentation and research is illustrated with several examples drawn from recent work in aquatic microbiology. The presentation is not intended to be exhaustive, but rather to be indicative of the valuable role of statistical methods in investigating questions that are typically encountered by aquatic microbiologists. Detailed information on most of the statistical methods can be found in standard textbooks. Multiple regression analysis, analysis of variance, contingency tables, linear regression and time-series analysis are the techniques used to track adsorption of viruses into soils, contamination of water supplies, survival of viruses in soils, and the source and path of well contamination. (See also W87-06201) (Lantz-PTT)
W87-06213

INTRODUCTION TO WATER QUALITY MODELLING.
John Wiley and Sons, Chichester, England. 1984. 234 p. Edited by A. James.

Descriptors: *Water quality management, *Model studies, Hydraulic models, Computer models, Mathematical models, Computer programs.

The text is a simple guide to water quality modeling, suitable for biologists, chemists, engineers and others without any previous knowledge of modelling or computing. The level of mathematical complexity has been deliberately restricted. An introductory chapter explains the concepts and terminology used in simulation, optimization and computer-aided design. This is followed by two other introductory chapters dealing with computing and numerical methods. The chapter on computing includes a guide to BASIC which is the simplest programming language in common use and the language used throughout the remainder of the book. The final introductory chapter explains the hydraulic, chemical and biological ideas which are used in formulating models of water quality. The remainder of the book is divided into two sections dealing with the application of modelling techniques to water pollution and wastewater treatment plants. Each chapter presents the modelling concepts and shows how these may be built into models suitable for examining frequently occurring problems. A complete listing of an example program is included as an appendix to each chapter. (See also W87-06217 thru W87-06230) (Lantz-PTT)
W87-06216

INTRODUCTION TO MATHEMATICAL MODELLING,
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
A. James.
IN: An Introduction to Water Quality Modelling, John Wiley and Sons, Chichester, England. 1984. p 1-16, 8 fig, 9 ref.

Descriptors: *Mathematical models, *Water quality management, *Management planning, Water quality standards, Model studies, Mathematical models, Simulation, Optimization, Computer models, Computers.

The proper management of water resources, even on a small scale, is very difficult. There are a large number of quality criteria to be considered and in most cases the level of each criterion is the resultant of complex interactions. The situation is further exacerbated by the difficulties of any experimental approach to forecasting water quality. This had led to the growth of mathematical modelling as a means of predicting quality. The representation of the interactions in a system by a set of equations is not a new idea. Classic work on oxygen sag has demonstrated these possibilities. But until recently, the application of mathematical modelling was limited by the difficulty of finding analytical solutions to the equations. It is the development of computing and numerical methods of solution that has led to increasing interest in modelling. Various kinds of mathematical models have been designed for different purposes, and are discussed in this chapter. They may be classified under three general headings: (a) simulation; (2) optimization; and (3) computer aided design. (See also W87-06216) (Lantz-PTT)
W87-06217

INTRODUCTION TO COMPUTING,
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W87-06218

INTRODUCTION TO NUMERICAL METHODS,
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W87-06219

MODELLING OF KINETICS,
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
A. James.
IN: An Introduction to Water Quality Modelling, John Wiley and Sons, Chichester, England. 1984. p 50-73, 11 fig, 5 ref, append.

Descriptors: *Kinetics, *Water quality management, *Model studies, Mathematical models, Simulation analysis, Physical kinetics, Chemical kinetics, Biological kinetics, Fate of pollutants, Mathematical equations, Mathematical analysis.

Many water quality models attempt to simulate changes in the concentration of substances which are in true solution, colloidal solution or in suspension. There are some substances which are sufficiently inert for their concentration to be regarded as unchanging (except by dilution). These are referred to as conservative substances and are often used as tracers. However, the majority of substances in water are subject to change in concentration due to physical, chemical and biological processes. An understanding of these processes is therefore useful in constructing water quality models of non-conservative substances. Also, many of the processes employed in the treatment of water and wastewaters rely on biological agencies (mainly bacteria) so an understanding of the kinetics of growth is helpful in design and operation. The following notes describe the ways of representing physical, chemical and biological kinetics, through an examination of solution equilibrium, chemical kinetics, homogeneous systems, heterogeneous systems, enzyme reactions, reactor theory, growth kinetics, etc. (See also W87-06216) (Lantz-PTT)
W87-06220

MODELS OF WATER QUALITY IN RIVERS,
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W87-06221

MATHEMATICAL MODELS OF THE DISCHARGE OF WASTEWATER INTO A MARINE ENVIRONMENT,
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
R. E. Featherstone.
IN: An Introduction to Water Quality Modelling, John Wiley and Sons, Chichester, England. 1984. p 150-162, 3 fig, 4 ref, append.

Descriptors: *Mathematical models, *Wastewater disposal, *Marine environment, *Path of pollutants, Fate of pollutants, Flow profile, Model studies.

A common method of wastewater disposal is to release it at some depth below the surface into a large body of water such as a lake or the sea by pipeline. The wastewater is released from the outfall either from a single open end or through a number of exit ports spaced along the pipeline in order to spread the release over a larger area. Recent field investigations into the unsatisfactory performance of some outfalls have revealed the establishment and growth of marine mollusc colonies inside the outfalls and outlet ports probably due to the flow of sea water into the outfall. This could be caused by low jet velocities in relation to sea currents and wave action. When wastewater is discharged from a pipe or diffuser into sea water the jet moves upward due to the buoyant force, which is proportional to the difference in density between the wastewater and the surrounding sea water. Dilution occurs as the 'buoyant' jet rises due to 'entrainment' of the sea water at the edge of the jet. The density differential therefore decreases with height and the jet may either become 'entrapped' below the surface or reach the surface depending on the depth of water above the outfall, the density stratification and velocity of the ambient and the hydraulic condition of the exit jet. Mathematical models which analyze this discharge and dilution are presented. (See also W87-06216) (Lantz-PTT)
W87-06224

GROUNDWATER QUALITY MODELLING,
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
R. E. Featherstone.
IN: An Introduction to Water Quality Modelling, John Wiley and Sons, Chichester, England. 1984. p 163-168, 2 fig, 6 ref.

Descriptors: *Mathematical models, *Groundwater quality, *Path of pollutants, Water quality control, Model studies, Hydraulic properties, Mathematical analysis, Mass transport, Fate of pollutants, Surface-groundwtaer relations.

The natural and, generally, high quality of groundwater may be seriously affected by many types and sources of contamination associated with human activities and land use. Groundwater pollution can arise from a variety of activities, notably: (1) the disposal of liquid effluent and sludge spreading directly on the outcrop of aquifers; (2) disposal on soil from which it can percolate downward to the aquifer; (3) from leachate by percolating surface water from solid waste tips, by seepage from sewage treatment ponds; (4) by subsurface disposal of radioactive liquid wastes; and (5) due to saltwater intrusion in coastal aquifers. Since groundwater flow sytems are hydraulically connected with surface water systems, groundwater pollution can, in turn, lead to surface water pollution, for example, nitrate pollution due to the application of artificial fertilizers and salinity increases in alluvial stream-aquifer systems related to irrigation practices. The governing equations of groundwater hydraulics, analytical solutions, and mass transport mathematical models are discussed. (See also W87-06216) (Lantz-PTT)
W87-06225

SIMULATION OF SOLUTE TRANSPORT: AN APPROACH FREE OF NUMERICAL DISPERSION,
Universidad Politecnica de Cataluna, Barcelona (Spain). Escuela Tecnica Superior de Ingenieros de

Caminos, Canales y Puertos.
J. Carrera, and G. Melloni.
Available from the National Technical Information Service, Springfield, VA. as DE87 005632 Price codes: A04 in paper copy, A01 in microfiche. Sandia National Laboratories, Albuquerque, NM. Report No. SAND86-7095, January 1987. 60 p, 14 fig, 1 tab, 36 ref. DOE Contract No. DE-AC04-76DP00789.

Descriptors: *Solute transport, *Path of pollutants, *Simulation analysis, *Numerical analysis, Dispersion, Mathematical studies, Mathematical equations, Algorithms.

The applicability of most algorithms for simulation of solute transport is limited either by instability or by numerical dispersion, as seen by a review of existing methods. A new approach is proposed that is free of these two problems. The method is based on the mixed Eulerian-Lagrangian formulation of the mass tranbsport problem, thus ensuring stability. Advection is simulated by a variation of reverse-particle tracking that avoids the accumulation of interpolation errors, thus preventing numerical dispersion. The algorithm has ben implemented in a one-dimensional code. Excellent results are obtained, in comparison with an analytical solution. (Author's abstract)
W87-06231

ACID SULPHATE SOILS: A BASELINE FOR RESEARCH AND DEVELOPMENT,
International Inst. for Land Reclamation and Improvement, Wageningen (Netherlands).
D. Dent.
International Institute for Land Reclamation and Improvement, P.O. Box 45, 6700 AA Wageningen, The Netherlands. ILRI Publication No. 39, 1986. 204 p, 60 fig, 23 tab, 42 photo, 147 ref.

Descriptors: *Acid sulfates, *Water pollution effects, *Acidic soils, Symposium, Information exchange, Agriculture, Environmental effects.

Acid sulfate soils suffer extreme acidity as a result of oxidation of pyrite. Often they are also unripe; sometimes also saline. Some occur naturally but most have developed as a result of drainage of previously waterlogged coastal alluvium and peat. Acid sulfate soils pose a range of problems for communities dependent on the reclaimed land - including low crop yields, a restricted range of alternative uses, soil engineering hazards, water pollution, and other environmental risks. These difficulties are not always anticipated, or reconized when they occur, or tackled with up-to-date information. There is a fund of expertise on the causes of, and the solutions to, the problems of these severely acid soils. Drawing together this information can be of benefit to many people, especially in the developing countries of the tropics. (Lantz-PTT)
W87-06233

CHARACTERIZATION OF SPILLED OIL SAMPLES: PURPOSE, SAMPLING, ANALYSIS AND INTERPRETATION.
Institute of Petroleum, London (England). Marine Environment Committee.
For primary bibliographic entry see Field 5A.
W87-06237

ACID RAIN: A WATER RESOURCES ISSUE FOR THE 80'S.
American Water Resources Association, Bethesda, MD.
American Water Resources Association, 5410 Grosvenor Lane, Bethesda, Maryland, 1983. 83 p. Edited by Raymond Hermann and A. Ivan Johnson.

Descriptors: *Acid rain, *Air pollution, *Path of pollutants, *Water pollution effects, Ecological effects, Fate of pollutants, Water pollution sources.

Individuals who deal with atmospheric deposition are constantly confronted with the realities and myths of 'acid rain.' The eleven papers included in this volume are a representation of the current ongoing research in the field. Throughout these presentations, the uncertainties regarding linkages between atmospheric processes and deposition, and physical or biological effects in ecosystems are stressed. The papers in this volume emphasize: the need for national and international cooperation owing to the global aspects and consequences of the acid precipitation issue; the need for a cohesive national response to this issue; the importance of atmospheric transport processes; interpretation of the historical footprint of acid precipitation; the physical processes which are potentially affected in both the sensitive and insensitive waters of the U.S., including streams, lakes, and wetlands; the associated effects of oxidants and related precursers; and the magnitude and scope of potential biological and ecological effects as determined by field and laboratory studies. As a group, these papers set the stage for a challenge to the water resources community. All levels of water resources activities are affected by questions regarding the widespread alteration of the chemistry of surface waters and groundwaters owing to acidification. The potential for new planning, design, and operational requirements will have resultant affects on management of water resources and of the biologically productive aquatic ecosystems they contain. (See also W87-06259 thru W87-06269) (Lantz-PTT)
W87-06258

GAS PHASE AND PRECIPITATION ACIDITIES IN THE COLORADO MOUNTAINS,
Colorado Coll., Colorado Springs. Dept. of Chemistry.
B. J. Huebert, R. B. Norton, M. J. Bollinger, D. D. Parrish, and C. Hahn.
IN: Acid Rain: A Water Resources Issue for the 80's, American Water Resources Association, 5410 Grosvenor Lane, Bethesda, Maryland, 1983. p 17-23, 7 fig, 19 ref.

Descriptors: *Acid rain, *Colorado, *Mountains, *Path of pollutants, *Nitrates, *Denver, *Water pollution effects, Fate of pollutants, Chemical analysis, Hydrogen ion concentration, Chromatography, Wind, Nitric acid, Snow, Scavenging.

For the past few years, both the gas phase concentrations of nitric acid, its precursors, and nitrate aerosols and the precipitation concentrations of nitrate were measured at Niwot Ridge, a remote area field site located at 3 km elevation in the Colorado mountains west of the Denver metropolitan area. The measurements were made using a variety of techniques: filter collection, ion chromatographic analysis, direct pH and conductivity determinations, and chemiluminescence detection. An extensive wind speed/wind direction network, coupled with trajectory analyses, provided meteorological support. The prevailing winds at the site are from the west, although occasionally the wind is from the east, across the metropolitan area in that direction. Correlations between the wind direction and the acidity levels, show that, despite the fact that east winds are atypical, the acidic components accompanying these winds are the likely major source of the relatively high acid deposition that occurs at the site. The observed nitric acid/precursor correlations are consistent with the current picture of the transformation chemistry. During the winter of 1980/81, it was shown that snow scavenges nitric acid and nitrate very efficiently. (See also W87-06258) (Author's abstract)
W87-06261

SPATIAL AND TEMPORAL TRENDS IN THE CHEMISTRY OF ATMOSPHERIC DEPOSITION IN NEW ENGLAND,
Maine Univ. at Orono. Dept. of Geological Sciences.
D. W. Hanson, and S. A. Norton.
IN: Acid Rain: A Water Resources Issue for the 80's, American Water Resources Association, 5410 Grosvenor Lane, Bethesda, Maryland, 1983. p 25-33, 11 fig, 12 ref.

Descriptors: *New England, *Acid rain, *Path of pollutants, *Quebec, *Soil chemistry, *Water pollution effects, *Heavy metals, Spatial distribution, Temporal distribution, Hydrogen ion concentration, Manganese, Calcium, Magnesium, Potassium, Zinc, Iron, Lead, Copper, Fate of pollutants.

Geochemical changes related to atmospheric deposition in New England and Quebec were evaluated by (1) transect studies of soil chemistry parallel to pH and metal deposition gradients; (2) chemical analysis of lake sediments with the following results: (a) Mn, Ca, Mg, K, Zn, Fe, and Pb concentrations and pH in organic litter of high altitude spruce-fir forests relate to the present pH gradients for precipitation and inferred gradients of heavy metal loading; (b) atmospheric deposition of heavy metals (including Pb, Zn, and Cu) began increasing in the 19th century in New England and may be leveling out in the last 5-10 years. Accelerated mechanical erosion may mask increases in concentration of these elements in lake sediments but deposition rate calculations indicate as muchas 12X increase in sediment accumulation rate of Pb due to atmospheric loading. Relative increases depend on increased loading, background values, and total deposition rate. Inferred acidification of precipitation and surface waters has resulted in increased leaching of Zn, Ca, Mg, Mn, and Al from soils and sediments with inferred concurrent increases in concentrations of these elements in surface waters. Results (a) and (b) imply that increasing atmospheric deposition of acids and metals has strongly influenced forest soils, sediment, and surface water chemistry. (See also W87-06258) (Author's abstract)
W87-06262

ACID PRECIPITATION AND BUFFER CAPACITY OF LAKES IN THE SIERRA NEVADA, CALIFORNIA,
California Univ., Santa Barbara. Dept. of Biological Sciences.
J. M. Melack, J. L. Stoddard, and D. R. Dawson.
IN: Acid Rain: A Water Resources Issue for the 80's, American Water Resources Association, 5410 Grosvenor Lane, Bethesda, Maryland, 1983. p 35-41, 3 fig, 2 tab, 27 ref.

Descriptors: *Acid rain, *Buffer capacity, *Lakes, *Sierra Nevada Mountains, *California, *Path of pollutants, *Water pollution effects, Fate of pollutants, Seasonal variation, Lake morphology, Hydrogen ion concentration, Bicarbonates.

The east central Sierra Nevada received acid precipitation (pH 3.7 to 4.9) during convective storms interspersed through the dry season of 1981. Sulfuric acid contributed about twice the acidity of nitric acid. In contrast, late autumn, winter, and early spring snow (1981-1982) ranged in pH from 5.2 to 6.1 (mean 5.7) and had low ammonium, nitrate, and sulfate concentrations. As of 1981 most of the alpine lakes of the Sierra Nevada remain very weakly buffered, bicarbonate lakes that receive a small loading of acid precipitation and a large annual input of snowmelt uncontaminated by strong acids. If the acidity of the precipitation increases, the pH of the lakes will decrease rapidly because the lakes and their basins have extremely low buffer capacity especially when runoff peaks during snow melt. (See also W87-06258) (Author's abstract)
W87-06263

ACID PRECIPITATION: THE IMPACT ON TWO HEADWATER STREAMS IN SHENANDOAH NATIONAL PARK, VIRGINIA,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5C.
W87-06264

IMPACT OF ATMOSPHERIC DEPOSITION ON THE WATER QUALITY OF EVERGLADES NATIONAL PARK,
Everglades National Park, Homestead, FL. South Florida Research Center.
For primary bibliographic entry see Field 5C.
W87-06265

OPTIONS FOR REACHING WATER QUALITY GOALS,
American Water Resources Association, Bethesda, MD.
For primary bibliographic entry see Field 5G.
W87-06270

CHESAPEAKE CHALLENGE: RESTORATION AND PROTECTION,
Environmental Protection Agency, Annapolis, MD. Chesapeake Bay Liaison Office.
For primary bibliographic entry see Field 5G.
W87-06273

POLICIES FOR CONTROLLING AGRICULTURAL NONPOINT SOURCE POLLUTION,
Conservation Foundation, Washington, DC.
For primary bibliographic entry see Field 5G.
W87-06274

EFFICIENT CONTROL OF AGRICULTURAL SEDIMENT DEPOSITION IN WATER COURSES,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 2J.
W87-06276

POINT AND NONPOINT SOURCE ABATEMENT NEEDS FOR IMPROVING INTERSTATE WATER QUALITY,
Tennessee Valley Authority, Knoxville.
For primary bibliographic entry see Field 5G.
W87-06279

ILLINOIS' PROCESS TO IDENTIFY, SCREEN AND PRIORITIZE RURAL WATER RESOURCE AND LAKE REHABILITATION PROJECTS,
Environmental Protection Agency, Chicago, IL. Region V.
For primary bibliographic entry see Field 5G.
W87-06282

EFFICIENCY OF ROADSIDE SWALES IN REMOVING HEAVY METALS FROM HIGHWAY ASSOCIATED NONPOINT SOURCE RUNOFF,
University of Central Florida, Orlando. Dept. of Civil Engineering and Environmental Sciences.
For primary bibliographic entry see Field 5G.
W87-06283

WATER QUALITY MAPPING WITH SIMULATED LANDSAT THEMATIC MAPPER DATA,
Ames Lab., IA.
For primary bibliographic entry see Field 7B.
W87-06286

USE OF AERIAL PHOTOGRAPHY IN DETECTION AND CHARACTERIZATION OF NONPOINT SOURCES OF POLLUTION,
Environmental Photographic Interpretation Center, Warrenton, VA.
For primary bibliographic entry see Field 7B.
W87-06287

WATER QUALITY MONITORING FOR THE TACHIA RIVER IN TAIWAN, REPUBLIC OF CHINA,
Ministry of Economic Affairs, Taipei (Taiwan). Water Resources Planning Commission.
For primary bibliographic entry see Field 7B.
W87-06288

HEAVY METALS IN NATURAL WATERS: APPLIED MONITORING AND IMPACT ASSESSMENT,
Alberta Environmental Centre, Vegreville.
J. W. Moore, and S. Ramamoorthy.
Springer-Verlag, New York, New York. 1984. 268 p, 48 fig, 85 tab, 745 ref.

Descriptors: *Heavy metals, *Water quality control, *Water pollution effects, *Path of pollutants, Environmental effects, Fate of pollutants, Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Zinc, Toxicity, Ecological effects, Monitoring.

The purpose of this book is threefold. First, there is an attempt to provide the reader with a critical review of large amounts of environmental data on heavy metals from several different disciplines. Such information should prove useful in the design and implementation of research projects, and the preparation of scientific papers and reports. Chosen for discussion are the eight most common heavy metals outlined in the EPA's priority list of pollutants: arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc. Environmental scientists and managers will almost certainly have to deal with this group during the course of routine monitoring and impact assessment. In addition, since a substantial body of information is available on the chemistry, uptake and toxicity of the eight metals, it is possible to assess their impact on aquatic systems. Some highly specific fields, such as pharmacokinetics, are not considered in detail in this volume. Such material, although relevant to several fields of study, cannot be directly used in monitoring and impact assessment. The second purpose of this book is to provide a review on the status and likely value of current methods used in monitoring and impact assessment. There is a critical evaluation of techniques which have been in use for many years and may no longer be relevant to current environmental problems. The final purpose is to show that the comprehensive, multidisciplinary approach is an effective means of detecting and evaluating potential hazards to aquatic resources and the users of the resources. (Lantz-PTT)
W87-06295

BOUNDARY ELEMENT - RANDOM WALK MODEL OF MASS TRANSPORT IN GROUNDWATER,
Kansas State Geological Survey, Lawrence.
For primary bibliographic entry see Field 2F.
W87-06301

CHLOROFORM SORPTION TO NEW JERSEY COASTAL PLAIN GROUND WATER AQUIFER SOLIDS,
New Jersey Agricultural Experiment Station, New Brunswick.
C. G. Uchrin, and G. Mangels.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 4, p 339-343, April 1986. 4 fig, 4 tab, 18 ref.

Descriptors: *Path of pollutants, *Carcinogens, *Adsorption, *Desorption, *Chloroform, *Aquifer solids, *Groundwater, Chemical processes, Aquifers, Coastal plains, New Jersey, Isotherms, Hysteresis.

Studies examining the adsorption/desorption characteristics of chloroform to New Jersey coastal plain aquifer solids were performed. Adsorption to the Cohansey aquifer solids, a coarse-to-fine-grade sand with a 4.4% organic matter content (2.6% organic carbon content), and to the Potomac-Raritan-Magothy aquifer solids, a sandy loam with a 2.2% organic matter content (1.3% organic carbon content), was found to be dependent on adsorber mass. Equilibrium adsorption could be characterized by either linear or Freundlich isotherms. Greater adsorption was achieved to the Cohansey material, which was attributed to its greater organic matter (carbon) content. Calculated normalized organic carbon partition coefficients were compared with values obtained from literature correlations. Consecutive desorption experiments displayed an apparent hysteresis. (Author's abstract)
W87-06310

COMPARISON OF PESTICIDE ROOT ZONE MODEL PREDICTIONS WITH OBSERVED CONCENTRATIONS FOR THE TOBACCO PESTICIDE METALAXYL IN UNSATURATED ZONE SOILS,
Environmental Research Lab., Athens, GA.
R. F. Carsel, W. B. Nixon, and L. G. Ballantine.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 4, p 345-353, April 1986. 6 fig, 5 tab, 20 ref.

Descriptors: *Model studies, *Metalaxyl, *Pesticides, *Path of pollutants, *Groundwater, *Leaching, *Degradation, Prediction, Transport, Calibrations, Performance evaluation, Florida, Maryland, Transformation, Regression analysis, Rainfall, Infiltration.

The pesticide root zone model (PRZM) was developed to evaluate pesticide leaching threats to ground water for different crops under varying climatic conditions, soil characteristics and cropping practices. PRZM was evaluated to establish its predictive capability by comparing observed metalaxyl concentration profiles with predicted concentration profiles using field-averaged pesticide data and best estimates for several hydrologic characteristics and pesticide transport properties at field sites in Florida and Maryland. Coefficients of determination for the Florida site at 26, 55 and 85 d after application of 0.33, 0.90 and 0.95, respectively, were obtained when field observations were regressed against model predictions. An overall coefficient of determination for the Maryland site of 0.75 was determined for 14 samplings after metalaxyl application. Pesticide transformation in the Florida soil was best described by a first-order model. A first-order degradation rate in soil of 0.014 d/ was estimated. Pesticide transformation in the Maryland soil was best described by a phased first-order model. A phase determination point that occurred 30 d after metalaxyl application was used to estimate soil degradation rates. Differences were attributed to the timing of rainfall events and soil infiltration characteristics. Estimated phased first-order degradation rates in soil for the Maryland site were 0.046 and 0.0045/d before and after the phase determination point. Evaluation of PRZM, using best estimates for transport and transformation properties of metalaxyl and limited calibration for water balance, suggests that the model effectively simulates the important processes operating on the pesticide. (Author's abstract)
W87-06311

UNSATURATED ZONE STUDIES OF THE DEGRADATION AND MOVEMENT OF ALDICARB AND ALDOXYCARB RESIDUES,
Union Carbide Agricultural Products Co., Inc., Research Triangle Park, NC.
R. L. Jones, J. L. Hansen, R. R. Romine, and T. E. Marquardt.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 4, p 361-372, April 1986. 3 fig, 12 tab, 22 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Groundwater, *Aldicarb, *Aldoxycarb, *Degradation, *Field tests, Drinking water, Agriculture, Monitoring, Drainage water, Unsaturated zone.

Unsaturated zone studies to measure the movement and degradation of aldicarb and aldoxycarb residues were conducted in 1983 at seven locations: Maricopa, Arizona; Harrellsville, North Carolina; Blackstone, Virginia; Blissfield, Michigan; Bluecast, Indiana; Pasco, Washington; and Fort Pierce, Florida. The Blissfield and Bluecast studies also included monitoring of tile-drain water and the Fort Pierce test included shallow ground water analyses. These research studies indicate that aldicarb or aldoxycarb residues will not enter drinking water supplies under agricultural conditions similar to those encountered in these seven field studies. Most, if not all, of the residues will degrade in the unsaturated zone at a rate corresponding to half-lives of between 0.5 and 2.0 months. The field studies also demonstrate that aldicarb and aldoxycarb residues degrade at about the same rate. (Author's abstract)
W87-06312

VALIDATION TRIAL OF PREDICTIVE FATE MODELS USING AN AQUATIC HERBICIDE (ENDOTHALL),
North Texas State Univ., Denton. Inst. of Applied Sciences.
K. H. Reinert, and J. H. Rodgers.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 5, p 449-461, May 1986. 6 fig, 7 tab, 30 ref.

Descriptors: *Model studies, *Fate of pollutants, *Biodegradation, *Endothall, *Herbicides, *EXAMS, *SLSA, Organic acids, Prediction, Calibrations, Field tests, Sediments, Plants, Detection limits, Dispersion.

Environmental risk assessment of pesticides in aquatic environments requires predictions of their persistence and compartmentalization. A strategy for developing confidence in predictive fate models, such as the Exposure Analysis Modeling System (EXAMS) and the Simplified Lake and Stream Analysis model (SLSA), is to test the models using carefully chosen chemicals in semi-controlled and field situations. For example, endothall, a relatively water-soluble aquatic herbicide, essentially has a sole fate process, biotransformation. This dicarboxylic acid was used to test the predictive capabilities of EXAMS and SLSA and to identify sources of variance in those predictions. The models were parameterized using laboratory, experimental pool and field measurements. Persistence and compartmentalization of endothall in the water, sediments and aquatic plants (Eurasian watermilfoil-Myriophyllum spicatum L.) contained in experimental pools were measured using gas chromatography. Both EXAMS and SLSA predicted aqueous compartment half-lives ranging from 7.3 to 7.8 d, whereas an aqueous half-life of 4 d was observed in the experimental pools. Endothall was introduced to areas within Pat Mayse Lake, a 2,400-ha reservoir in north central Texas, as part of an aquatic plant management program for M. spicatum. Concentrations of endothall were below detection limits (0.002 mg/L water, 0.01 mg/kg sediment) in 2 to 3 d and in 4 d in the water and sediment compartments, respectively. EXAMS and SLSA predicted half-lives ranging from 3 to 6 d in the water column. Observed aqueous half-lives ranged from 0.1 to 0.23 d. Horizontal dispersion and dilution contributed significantly to the dissipation of endothall at these sites. Predicted concentrations of endothall in sediment were similar to the measured concentrations. This study is one validation trial of EXAMS and SLSA in which the models were not considered validated. (Author's abstract)
W87-06319

TOXICOKINETICS OF FENVALERATE IN RAINBOW TROUT (SALMO GAIRDNERI),
Iowa State Univ., Ames. Dept. of Entomology.
For primary bibliographic entry see Field 5C.
W87-06328

METHOXYCHLOR DISTRIBUTION, DISSIPATION, AND EFFECTS IN FRESHWATER LIMNOCORRALS,
Canadian Centre for Toxicology, Guelph (Ontario).
K. R. Solomon, J. Y. Yoo, D. Lean, N. K. Kaushik, and K. E. Day.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 6, p 577-586, June 1986. 6 fig, 2 tab, 18 ref.

Descriptors: *Methoxychlor, *Limnology, *Path of pollutants, *Water pollution effects, Adsorption, Sediments, Water chemistry, Nitrites.

Methoxychlor was applied to 125-cu m limnocorrals at nominal concentrations of 3 and 300 microgram(ug)/L in 1981 and of 5 and 50 ug/L in 1982. The half-life of methoxychlor in water ranged from 6 to 13 d; however, methoxychlor was strongly adsorbed to and slowly released from the polyethylene liners and the sediments on the bottom of the enclosures. Forced mixing of methoxychlor in the water resulted in greater adsorption to the sediments than did surface application. Methoxychlor had little effect on water chemistry parameters, although nitrite and dissolved inorganic carbon concentrations were higher in the treated than in the control corrals in each year of the study. (See also W87-06330) (Author's abstract)
W87-06329

PARTITIONING OF HEAVY METALS TO SUSPENDED SOLID OF THE FLINT RIVER, MICHIGAN,
Clarkson Coll. of Technology, Potsdam, NY. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 2K.
W87-06331

BIOCONCENTRATION OF HYDROPHOBIC CHEMICALS IN FISH: RELATIONSHIP WITH MEMBRANE PERMEATION,
Amsterdam Univ. (Netherlands). Lab. of Environmental and Toxicological Chemistry.
F. A. P. C. Gobas, A. Opperhuizen, and O. Hutzinger.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 7, p 637-646, July 1986. 5 fig, 23 ref.

Descriptors: *Water pollution effects, *Path of pollutants, *Model studies, *Bioaccumulation, *Membrane processes, *Organic compounds, *Fish physiology, Hydrophobicity, Lipids, Fish, Kinetics, Metabolism.

A model is presented for the bioconcentration in fish of nonpolar hydrophobic chemicals that are not metabolized. The model assumes that diffusion rates through membrane-diffusion layer barriers influence uptake and depuration kinetics in fish. For extremely hydrophobic (log K sub d,oct > 3 to 4) chemicals, uptake rate constants in fish are independent of the solute's hydrophobicity, whereas for low to moderately hydrophobic chemicals proportionality between these parameters is observed. Additionally, elimination rate constants for low to moderately hydrophobic chemicals are independent of the solute's hydrophobicity. In contrast, the elimination rate constants for extremely hydrophobic chemicals, such as polychlorobenzenes and -naphthalenes, are inversely proportional to hydrophobicity. In the model presented, this is due to the rates of release from the lipid compartments of the fish. The general relationships between bioconcentration kinetic parameters and hydrophobicity are in agreement with experimental data. (Author's abstract)
W87-06332

MOVEMENT OF KEPONE(R) (CHLORDECONE) ACROSS AN UNDISTURBED SEDIMENT-WATER INTERFACE IN LABORATORY SYSTEMS,
Environmental Research Lab., Gulf Breeze, FL.
P. H. Pritchard, C. A. Monti, E. J. O'Neill, J. P. Connolly, and D. G. Ahearn.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 7, p 647-657, July 1986. 7 fig, 2 tab, 24 ref. EPA Cooperative agreement R 809370-01.

Descriptors: *Sediment-water interfaces, *Path of pollutants, *Sediments, *Kepone, *Chlordecone, *Model studies, *Partition coefficient, Diffusion, Organic compounds, Pesticides, Prediction, Distribution.

The distribution of Kepone(R) (chlordecone) in a sediment bed after various periods of continuous toxicant input to the overlaying water column was determined in a laboratory system. Most of the Kepone was found to accumulate in the top 0.6 to 1.5 cm of sediment. A mathematical model was developed to predict Kepone concentrations with depth over time in the sediment. An equilibrium partition coefficient was determined from batch sorption tests and a molecular diffusion coefficient for Kepone was estimated from an empirical relationship between diffusivity and molecular weight. A computed Kepone distribution based on diffusion rates that decreased with depth and with incubation time gave the best fit to the observed data. We attribute the apparently faster rates in the upper sediment to mixing between interstitial and overlying water. Our results illustrate the value of models in conjunction with laboratory studies in defining the interactions of pollutants with sediment beds. (Author's abstract)
W87-06333

MAYFLY-MEDIATED SORPTION OF TOXICANTS INTO SEDIMENTS,
Fish and Wildlife Service, Washington, DC. Div. of Resource Contaminant Assessment.
S. Gerould, and S. P. Gloss.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 7, p 667-673, July 1986. 5 fig, 14 ref. EPA Interagency agreement AD-14-8-0-183-0.

Descriptors: *Path of pollutants, *Sediments, *Mayflies, *Sorption, *Organic compounds, *Isotope studies, Burrows, Toxicity.

Experiments were conducted to determine the influence of the burrowing mayfly, Hexagenia limbata, on the movement of dihexylphthalate (DHP) and hexachlorobenzene (HCB) from the water column into the sediment. Beakers containing sediment and mayflies were introduced into flow-through aquaria and were sampled at intervals up to 5 d. Sediment was taken from surface and subsurface areas with and without mayflies. The two experiments were run at concentrations of (14C)DHP and (14C)HCB of 0.066 and 0.062 ng/L, respectively. Subsurface sediment without mayflies was uncontaminated. Toxicant concentration, based on area (ng/sq cm), was greater at the surface than on the burrow walls for both compounds. Concentration in the bottom of the burrow was greater than that in the middle (5 cm deep) for DHP but similar to that at the middle for HCB. Total mass of DHP in the burrow wall was about equal to the mass on the surface, indicating that mayflies were capable of doubling the amount of DHP sorbed onto a given surface area of sediment. The adsorption of contaminants from water pulsed through mayfly burrows increased the depth of penetration and mass of contaminants in subsurface sediments. (Author's abstract)
W87-06334

SELENIUM BIOACCUMULATION IN GONADS OF LARGEMOUTH BASS AND BLUEGILL FROM THREE POWER PLANT COOLING RESERVOIRS,
Columbia National Fisheries Research Lab., MO.
P. C. Baumann, and R. B. Gillespie.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 7, p 695-701, July 1986. 3 fig, 2 tab, 17 ref.

Descriptors: *Bass, *Bluegills, *Path of pollutants, *Cooling water, *Reservoirs, *Effluents, *Selenium, *Bioaccumulation, Tissue analysis, Industrial wastewater.

Male and female largemouth bass (Micropterus salmoides, Lacepede) and bluegills (Lepomis macrochirus, Rafinesque) were collected from two power plant cooling reservoirs that received ash pond effluent (Hyco and Catfish Reservoirs, North Carolina) and one that did not (Lake Sangchris, Illinois). Bluegills were also collected from a city reservoir (Roxboro City Lake, North Carolina) that received no industrial effluent. Selenium residues were determined separately in the gonads and in the carcasses of all fish collected. Residues in both carcasses and gonads were significantly higher in fish from reservoirs receiving ash pond effluent. Ovarian selenium concentrations were greater than testicular levels, while concentrations in carcass did not differ between the sexes. Selenium concentrations were significantly higher in the ovaries than in the rest of the carcass in both largemouth bass and bluegills. In males, selenium levels declined in gonads relative to those in the carcass as selenium concentrations in the carcass increased, but no such pattern was evident in females. Bioaccumulation resulted in selenium concentrations 1,000 times higher in the ovaries of bluegills than in the water from which the fish were collected. (Author's abstract)
W87-06335

DDT CONTAMINATION OF A NORTH ALABAMA AQUATIC ECOSYSTEM,
Alabama Univ. in Birmingham. School of Public Health.
A. R. Reich, J. L. Perkins, and G. Cutter.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 8, p 725-736, August 1986. 5 fig, 3 tab, 15 ref.

Descriptors: *Water pollution sources, *DDT, *Bioaccumulation, *Outfall, *Sediments, *Macroinvertebrates, *Path of pollutants, *Streams, Indian Creek, Alabama, Tennessee Valley Authority, Aquatic ecosystems, Tissue analysis.

Between 1947 and 1970, Olin Chemical Company discharged an estimated 432000 to 8000000 kg of DDT residues (DDT, DDD and DDE) into Huntsville Spring Branch and Indian Creek in Alabama. Residents of Triana, Alabama, located approximately 10 mi downstream from the outfall, were found to have high tissue levels of DDT residues. A comprehensive investigation of the contaminated area conducted by Tennessee Valley Authority and others in 1979 indicated extensive contamination of the ecosystem. This study investigated the environmental dynamics of DDT residues in the Huntsville Spring Branch-Indian Creek aquatic ecosystem by assessing residue levels in sediment, water and benthic macroinvertebrates collected in September 1983 during a 3-d period. Analytical results revealed continued heavy DDT residue contamination of all three media. Water and sediment data exhibited an exponential decrease in residues with increasing distance below the outfall. Sediments showed concentrations of residues of up to 2% by weight. Benthic macroinvertebrates also displayed high levels of DDT residues. Water bioconcentration factors ranged from 1,737 to 99,700 for total residues. DDT residue levels in Indian Creek-Huntsville Spring Branch are still extremely high 14 years after the input of DDT was stopped. There has been no significant change in contamination levels during the 4-year interim between this study and the previous TVA study. (Author's abstract)
W87-06337

SEASONAL EFFECTS ON MICROBIAL TRANSFORMATION RATES OF AN HERBICIDE IN A FRESHWATER STREAM: APPLICATION OF LABORATORY DATA TO A FIELD SITE,
Environmental Research Lab., Athens, GA.
D. L. Lewis, L. F. Freeman, and M. E. Watwood.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 9, p 791-796, September 1986. 3 fig, 7 ref.

Descriptors: *Fate of pollutants, *Herbicides, *Biodegradation, *Seasonal variation, *Streams, *Path of pollutants, Temperature effects, Microbial transformation.

Seasonal effects on microbial transformation rates of an herbicide, 2,4,-dichlorophenoxyacetic acid butoxyethyl ester (2,4-DBE), in a freshwater stream were investigated using low concentrations (less than 100 microgram(ug)/L) of the herbicide mixed with an inert dye, rhodamine WT, to correct for dilution. Although water temperatures decreased from 22 + or - 0.5 to 8.0 + or - 0.5 C and water velocities decreased from 0.09 + or - 0.01 to 0.03 + or - 0.003 m/s, microbial transformation rates, as indicated by pseudo-first-order transformation rate coefficients, increased as much as threefold in the cold months over those in the spring and summer. The increased winter transformation rates were associated with leaf-litter accumulation, which provided additional colonized surface area in the stream. Therefore, the increased colonized surface area more than compensated for the effects of temperature and water velocity (under conditions of mass-transport limitation) that otherwise would have reduced microbial transformation rates in the winter months. (Author's abstract)
W87-06341

AQUEOUS PHOTOLYSIS OF TRICLOPYR AND ITS BUTOXYETHYL ESTER AND CALCULATED ENVIRONMENTAL PHOTODECOMPOSITION RATES,
Dow Chemical U.S.A., Midland, MI. Agricultural Products Dept.
P. J. McCall, and P. D. Gavit.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 10, p 879-885, October 1986. 6 fig, 2 tab, 10 ref.

Descriptors: *Fate of pollutants, *Triclopyr, *Computer programs, *Degradation, *SOLAR, Transport, Transformation, Photolysis.

Studies determining the photochemical quantum yields of ((3,5,6-trichloro-2-pyridinyl) oxy) acetic acid (triclopyr) and its butoxyethyl ester are reported. Values of 0.040 + or - 0.003 and 0.0084 + or - 0.0008, respectively, were obtained using 313-nm light at pH 5 in a dilute aqueous solution at 35 C. Quantum yields were used to compute half-lives for direct photolysis under seasonal and locational sunlight conditions with the computer program SOLAR. Triclopyr was observed to photodegrade approximately six times faster than the ester, with typical calculated midday, midsummer half-lives of 2.1 and 12.5 h, respectively, at the water's surface at 40 C latitude. The relative importance of photolysis to other environmental transport and transformation mechanisms of the chemicals is discussed. (Author's abstract)
W87-06345

CHEMICAL SPECIATION AND BIOAVAILABILITY OF COPPER: UPTAKE AND ACCUMULATION BY EICHORNIA,
Washington State Univ., Pullman. Dept. of Agronomy and Soils.
Y. M. Nor, and H. H. Cheng.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 11, p 941-947, November 1986. 4 fig, 3 tab, 27 ref.

Descriptors: *Bioaccumulation, *Path of pollutants, *Water hyacinth, *Bioassay, *Speciation, *Copper, Cultures, Humic acids, Fulvic acids, Heavy metals, Inhibition, Chelation, Ligands, Plant physiology.

The uptake of copper by water hyacinth (Eichornia crassipes) was studied using solution culture techniques in the greenhouse. The bioassays indicated that the uptake of copper was a direct function of its speciation. For example, only free Cu(2+) was absorbed by the plant in the presence of strong ligands such as EDTA and humic acid. Other ligands tested (fulvic acid, amino acids and simple organic acids), however, failed to suppress the uptake of copper even when the free Cu(2+) in solution initially was negligibly small. Copper could have been taken up directly by the plant as various complexes or in the free Cu(2+) form after dissociation from the ligands prior to uptake. Complete inhibition of copper uptake in the presence of humic acid, in contrast to fulvic acid, suggests that the chemical stability constants of these complexes with copper were not correlated to the metal's bioavailability. The potential of Eichornia for removing heavy metals from wastewaters is demonstrated by its tremendous capacity to bioaccumulate copper. Depending on the presence or absence of ligands, from 200 to more than 2,400 microgram Cu/g dry matter could be taken up by the plant. (Author's abstract)
W87-06349

SORPTION OF LOW-POLARITY ORGANIC COMPOUNDS ON OXIDE MINERALS AND AQUIFER MATERIAL,
Air Force Engineering and Services Center, Tyndall AFB, FL. Engineering and Services Lab.
For primary bibliographic entry see Field 2K.
W87-06350

TRACKING RIVER PLUMES WITH VOLATILE HALOCARBON CONTAMINANTS: THE ST. CLAIR RIVER-LAKE ST. CLAIR EXAMPLE,
National Water Research Inst., Burlington (Ontario). Environmental Contaminants Div.
K. L. E. Kaiser, and M. E. Comba.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 11, p 965-976, November 1986. 9 fig, 1 tab, 20 ref.

Descriptors: *Path of pollutants, *Organic compounds, *St. Clair River, *Pollution load, *Plumes, *Lakes, *Rivers, *Lake St. Clair, Halocarbons, Chlorinated solvents.

The concentrations of seven widespread, volatile, halocarbon contaminants: tetrachloroethylene (C2Cl4), carbon tetrachloride (CCl4), 1,1,1-trichloroethane (C2H3Cl3), trichloroethylene (C2HCl3), chloroform (CHCl3), bromodichloromethane (CHBrCl2) and Freon 12 (CCl2F2) - were determined in the lower reaches of the St. Clair River and throughout Lake St. Clair. The results indicate large inputs of carbon tetrachloride and tetrachloroethylene and smaller loadings of chloroform, 1,1,1-trichloroethane and trichloroethylene from the St. Clair River, particularly the South Channel, Bassett Channel and Chenal Ecarte, to Lake St. Clair. In total, daily loadings of more than 100 kg are indicated, resulting in a lake burden of approximately 1,000 kg of these halocarbons. The plumes of contaminated river water, particularly for carbon tetrachloride and tetrachloroehtylene, extend approximately 15 km into the shallow, well-mixed lake. At that range, the halocarbon levels generally drop to near-background concentrations, suggesting significant removal of the waterborne contaminants through volatilization. (Author's abstract)
W87-06352

PHYSICAL AND CHEMICAL FACTORS THAT INFLUENCE THE ANAEROBIC DEGRADATION OF METHYL PARATHION IN SEDIMENT SYSTEMS,
Environmental Research Lab., Athens, GA.
N. L. Wolfe, B. E. Kitchens, D. L. Macalady, and T. J. Grundl.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 12, p 1019-1026, December 1986. 6 fig, 3 tab, 12 ref.

Descriptors: *Fate of pollutants, *Methyl parathion, *Sediments, *Kinetics, *Degradation, Pesticides.

The kinetics of disappearance of methyl parathion (O,O-dimethyl-O-p-nitrophenyl phosphorothioate) were studied in anaerobic sediment samples in the laboratory as a function of methyl parathion concentration, pH and Eh. The disappearance of methyl parathion is described by first-order kinetics and amino methyl parathion (O,O-dimethyl-O-p-aminophenyl phosphorothioate) was identified as a reduction product. In the strongly reducing sediments, the half-lives were on the order of a few minutes. In water isolated from the sediment, no reaction could be detected over the period of a week. Also, there is no apparent correlation between the first-order disappearance rate constants and the pH of the sediment samples. In heat-sterilized sediments, the disappearance rate constants are retarded about two orders of magnitude relative to nonsterile sediments. In chemically treated sediments, first-order disappearance rate constants are comparable to those in the nonsterile system. (Author's abstract)
W87-06355

COMPARISON OF COMPUTER MODEL PREDICTIONS WITH UNSATURATED ZONE FIELD DATA FOR ALDICARB AND ALDOXYCARB,
Union Carbide Agricultural Products Co., Inc., Research Triangle Park, NC.
R. L. Jones, G. W. Black, and T. L. Estes.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 12, p 1027-1037, December 1986. 6 fig, 2 tab, 31 ref.

Descriptors: *Path of pollutants, *Simulation, *Aldicarb, *Aldoxycarb, *Field tests, *Leaching, *Model studies, Soil properties, Rainfall, Irrigation, Pesticides, Groundwater, Agriculture.

The ability of the Pesticide Root Zone Model (PRZM) to simulate the movement of aldicarb or aldoxycarb residues was evaluated using the soil properties and amounts of rainfall and irrigation measured in 34 unsaturated zone field study plots. Maximum leaching depth values obtained from the PRZM simulations agreed relatively well with those observed in the field experiments. Where irrigation water was applied in spatially nonuniform patterns to a field (as in furrow or flood irrigation), simulations show that the placement of the pesticide in relation to irrigation water must also be considered. The comparisons presented show that PRZM (if supplied with the proper degradation rates and appropriate soil, weather and agricultural parameters) can be used to assess movement of pesticides in agricultural environments. When used in conjunction with multiple year rainfall records, this model can be used to develop probability distributions of pesticide movement in the unsaturated zone. PRZM can also be linked to a ground water solute transport model to provide predictions of pesticide concentrations and transport in ground water. These techniques are useful in performing risk assessments and in developing potential management practices when needed. (Author's abstract)
W87-06356

TOXICOLOGICAL STUDIES OF BENOMYL AND CARBENDAZIM IN RAINBOW TROUT, CHANNEL CATFISH AND BLUEGILLS,
Columbia National Fisheries Research Lab., MO.
For primary bibliographic entry see Field 5C.
W87-06357

XENOBIOTIC METABOLISM OF P-NITROPHENOL DERIVATIVES BY THE RICE FIELD CRAYFISH (PROCAMBARUS CLARKII),
California Univ., Davis. Dept. of Environmental Toxicology.
G. D. Foster, and D. G. Crosby.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 12, p 1059-1070, December 1986. 3 fig, 6 tab, 22 ref. NIEHS Grant ES07059.

Descriptors: *Fate of pollutants, *Metabolism, *Crayfish, *Isotope studies, Population exposure, Tissue analysis, Depuration, Chromatography, Adsorption, Bioaccumulation.

The extent and routes of metabolism affect the bioconcentration and toxicity of xenobiotics in crayfish. To investigate the in vivo xenobiotic metabolism of three p-nitrophenol derivatives, rice field crayfish were exposed to 0.1 to 0.01 mg/L 14C-substrate solutions for 15 h. At apparent steady-state uptake, the crayfish were transferred to a recycling flow-through metabolism chamber for 24 h where the depurated products were collected and concentrated on a column of Amberlite XAD-4 resin. The tissue absorption and distribution of 14C-compounds at the apparent steady-state and post depuration periods were measured by complete tissue combustion and recovery of evolved 14CO2. The structure and concentration of metabolites in resin and soft tissue extracts were determined by cochromatography with authentic standards in HPLC and TLC systems. The crayfish rapidly absorbed the radio labeled chemicals from solution and depurated metabolites of oxidation and conjugation reactions. The most prominent metabolites were the Beta-D-glucosides of the free phenols, with lesser amounts of the corresponding sulfate esters. Observed oxidations included O-demethylation, aromatic sidechain oxidation and phosphorothicate deesterification. Body burdens of the original p-nitrophenol derivatives were markedly reduced by the presence of these metabolic transformations. (Author's abstract)
W87-06360

RELATIONSHIP BETWEEN AQUATIC TOXICITY QSARS AND BIOCONCENTRATION FOR SOME ORGANIC CHEMICALS,
Ontario Ministry of Labour, Toronto. Special Studies and Services Branch.
For primary bibliographic entry see Field 5C.
W87-06361

TEMPORAL AND SPATIAL VARIABILITY IN ZN, CR, CD AND FE CONCENTRATIONS IN OYSTER TISSUES (CRASSOSTREA BRASILIANA LAMARCK, 1819) FROM SEPETIBA BAY, BRAZIL,
Universidade Federal do Rio de Janeiro (Brazil). Inst. de Biofisica.
N. R. W. Lima, L. D. de Lacerda, W. C. Pfeiffer, and M. Fiszman.
Environmental Technology Letters ETLEDB, Vol. 7, No. 8, p 453-460, August 1986. 2 fig, 3 tab, 12 ref.

Descriptors: *Bioaccumulation, *Path of pollutants, *Heavy metals, *Tissue analysis, *Oysters, *Bioindicators, *Sepetiba Bay, Brazil, Zinc, Chromium, Cadmium, Iron, Metal-finishing wastes, Metallurgy, Ribeira Bays, Effluents, Temporal distribution, Spatial distribution.

Temporal and spatial variability in concentrations of Zn, Cr, Cd, and Fe in the soft tissues of C. brasiliana from Sepetiba and Ribeira Bays, Brazil, were determined for three different periods. Sepetiba Bay has been subjected to metallurgical industry effluents for two decades. Significant spatial differences were observed for Zn and Cd, but no temporal variations were detected. High correlations were found between Zn and Cd. C. brasiliana proved to be a good ecological indicator for Zn and Cd monitoring programs. (Author's abstract)
W87-06364

TOTAL MERCURY IN MARINE SEDIMENTS NEAR A SEWAGE OUTFALL. RELATION WITH ORGANIC MATTER,
Instituto Nacional de Investigacion y Desarrollo Pesquero, Mar del Plata (Argentina).
J. E. Marcovecchio, R. J. Lara, and E. Gomez.
Environmental Technology Letters ETLEDB, Vol. 7, No. 9, p 501-507, September 1986. 3 fig, 1 tab, 25 ref.

Descriptors: *Outfall sewers, *Waste disposal, *Path of pollutants, *Mercury, *Marine sediments, *Sewage disposal, *Organic matter, Argentina, Bahia Blanca, Humic substances, Silt, Clay, Proteins, Tides, Adsorption.

Total Hg content of sediments affected by a sewage outfall (Canal Vieja, which receives the untreated effluent of Bahia Blanca, Argentina, a city of 300,000 population) were determined and correlated with other parameters (humic substances, protein content, and percentage silt-clay). A marked positive correlation was found between total Hg and humic substance contents of these sediments. Hg distribution seemed to be influenced not only by certain physical process (e.g., tidal ebb and flow, adsorption), but by biological and chemical processes as well. (Author's abstract)
W87-06367

ALKYLLEAD COMPOUNDS IN SURFACE AND POTABLE WATERS,
Essex Univ., Colchester (England). Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W87-06369

RARE EARTH ELEMENT CONTENT OF SEWAGE SLUDGES DUMPED AT SEA IN LIVERPOOL BAY, U.K.,
Lancaster Univ., Bailrigg (England). Lancashire and Western Sea Fisheries Joint Committee.
For primary bibliographic entry see Field 5E.
W87-06372

CALCULATING THE IMPACT OF A MOMENTARY INPUT OF A DECAYING SOLUTE - AND ITS DECAY COMPONENTS - ON THE QUALITY OF OUTFLOWING GROUNDWATER,
Agricultural Univ., Wageningen (Netherlands). Dept. of Land and Water Use.
H. C. Van Ommen.
Journal of Hydrology JHYDA7, Vol. 89, No. 1/2, p 59-64, December, 1986. 1 fig, 1 tab, 5 ref.

Descriptors: *Path of pollutants, *Radioisotopes, *Groundwater movement, *Groundwater pollution, *Solute transport, *Mathematical models, Breakthrough curve, Radioactive half-life, Solutes.

Using the analogy between the breakthrough curve of solute transport from a diffuse source and the effluent concentration of a perfectly stirred tank, the evolution of the concentration in outflowing groundwater concerning an arbitrary component of the radioactive decay chain is presented. As an illustration of the method, and example of a hypothetical decay chain is presented. Consequences and recommendations for practical use are discussed. (Author's abstract)
W87-06378

INVESTIGATIONS INTO THE FACTORS INFLUENCING LONG RANGE MATRIX DIFFUSION RATES AND PORE SPACE ACCESSIBILITY AT DEPTH IN GRANITE,
UKAEA Atomic Energy Research Establishment, Harwell (England). Chemistry Div.
For primary bibliographic entry see Field 5E.
W87-06383

CHROMIUM, NICKEL, COPPER, ZINC, ARSENIC, SELENIUM, CADMIUM, MERCURY AND LEAD IN DUTCH FISHERY PRODUCTS 1977-1984,
Rijks-Kwaliteitsinstituut voor Land-en Tuinbouwprodukten, Wageningen (Netherlands).
For primary bibliographic entry see Field 5A.
W87-06388

ACCUMULATION OF CADMIUM, MERCURY, AND LEAD BY VEGETABLES FOLLOWING LONG-TERM LAND APPLICATION OF WASTEWATER,
Tehran Univ. (Iran). School of Pharmacy.
M. Shariatpanahi, and A. C. Anderson.
The Science of the Total Environment STENDL, Vol. 52, No. 1/2, p 41-47, June 1986. 3 tab, 8 ref.

Descriptors: *Path of pollutants, *Waste disposal, *Bioaccumulation, *Heavy metals, *Vegetables, *Land disposal, *Soil contamination, *Wastewater disposal, Tehran, Iran, Garden cress, Onions, Leeks, Radishes, Mint, Tarragon, Basil, Cadmium, Mercury, Lead, Toxicity, Irrigation.

Several vegetable species that are part of the daily diet of Tehran's population were examined for potential uptake of Cd, Hg, and Pb from soils following long-term land application of wastewater. The three study sites, located in the south of Tehran, have received untreated domestic wastewater by flood irrigation for many years. Elevated levels of the three elements were found in the upper layers of soil. The examined vegetables (garden cress, onion, leeks, radish, mint, tarragon, and basil) accumulated some Cd, Hg, and Pb, but at relatively low levels. Due to the low concentration of these metals and their poor absorption from the gastrointestinal tract (excluding absorption of Pb in children), it does not appear that the short-term consumption of these contaminated vegetables would produce acute toxicity. However, since absorption of dietary Pb in children is relatively high and children are very sensitive to Pb toxicity, short-term consumption of these vegetables plus other environmental sources of these metals in Tehran may produce chronic effects in children. (Author's abstract)
W87-06389

EMBRYONIC MORTALITY AND ABNORMALITIES OF AQUATIC BIRDS: APPARENT IMPACTS OF SELENIUM FROM IRRIGATION DRAINWATER,
California Univ., Davis. Dept. of Wildlife and Fisheries Biology.
For primary bibliographic entry see Field 5C.
W87-06390

BIODEGRADATION OF USED MOTOR OIL BY BACTERIA PROMOTES THE SOLUBILIZATION OF HEAVY METALS,
Geneva Univ. (Switzerland). Dept. de Biologie Vegetale.
R. Vazquez-Duhalt, and H. Greppin.
The Science of the Total Environment STENDL, Vol. 52, No. 1/2, p 109-121, June 1986. 4 fig, 4 tab, 34 ref.

Descriptors: *Fate of pollutants, *Hydrocarbon metabolism, *Solubility, *Biodegradation, *Bacterial physiology, *Heavy metals, *Motor oil, Lead, Zinc, Copper, Nickel, Chromium, Cadmium, Bacteria, Growth, Metabolism.

The influence and fate of heavy metals (Pb, Zn, Cu, Cr, Ni, and Cd) were determined during bacterial growth in a medium composed of used motor oil. Growth was apparently not affected by the relatively high level of heavy metals in the oil. The metals were transferred to the aqueous phase during bacterial growth. The relationship between bacterial growth, hydrocarbon metabolism, and metal solubilization was analyzed. The concentration of Cd in used motor oil was determined. (Author's abstract)
W87-06391

LABORATORY STUDIES ON THE REMOBILISATION OF ACTINIDES FROM RAVENGLASS ESTUARY SEDIMENT,
UKAEA Atomic Energy Research Establishment, Harwell (England). Environmental and Medical Sciences Div.
P. J. Burton.
The Science of the Total Environment STENDL, Vol. 52, No. 1/2, p 123-145, June 1986. 3 fig, 15 tab, 30 ref. Commission of European Communities Contract BIO-D-334-81-UK(H).

Descriptors: *Path of pollutants, *Estuaries, *Sediments, *Ravenglass Estuary, *Actinides, *Marine sediments, *Irish Sea, *Radioactive wastes, Plutonium, Americium, Oxidation process, Chemical reduction, Carbonates, Salinity, Industrial wastes, Transport, Tidal effects.

Actinides from the British Nuclear Fuels Limited Sellafield nuclear reprocessing plant are discharged into the Irish Sea and have accumulated in Ravenglass Estuary, 10 km to the southeast. Laboratory experiments were conducted with actinide-bearing intertidal sediments to investigate the effect of different conditions on the distribution coefficients (K sub d) for plutonium and americium. Using inactive seawater from the North Sea, K sub d values of 1100000 and 2000000 were obtained for Pu-239+240 and Am-241, respectively. For Pu, and oxidation-reduction process was observed, with the sediment itself able to reduce Pu(V/VI) to Pu(III/IV). With Am, the formation of a soluble carbonate complex is thought to occur. With low salinity (eg, at low tide in the upper estuary), K sub d values decreased by about two orders of magnitude. This was due, in part, to the associated drop in pH. A mechanism for the transport of remobilized actinides on suspended particulate material is postulated to explain the recent observation of a loss of actinides from the Ravenglass Estuary to the Irish Sea. (Author's abstract)
W87-06392

HEAVY METALS AND ESSENTIAL ELEMENTS IN LIVERS OF THE POLAR BEAR (URSUS MARITIMUS) IN THE CANADIAN ARCTIC,
National Wildlife Research Centre, Ottawa (Ontario).
R. J. Norstrom, R. E. Schweinsberg, and B. T. Collins.
The Science of the Total Environment STENDL, Vol. 48, No. 3, p 195-212, February 1986. 5 fig, 5 tab, 31 ref.

Descriptors: *Tissue analysis, *Path of pollutants, *Polar bears, *Livers, *Heavy metals, *Arctic, Canada, Statistics, Age, Sex, Mercury, Cadmium, Selenium, Copper, Marine mammals, Beaufort Sea, Equations, Detection limits, Spatial distribution.

Polar bear livers (67) from six Management Zones in the western and central Canadian Arctic were analyzed for 22 elements. Ba, Be, Co, Mo, Ti, V, and Zr were near the detection limit in all cases. Baseline data were obtained for the remaining elements (Ag, As, Ca, Cd, Cu, Fe, Hg, K, Mg, Mn, Na, P, Se, Sr, and Zn). No statistically significant effect of age, sex, or geographical location was found for any of the elements, except Cd, Hg, and Se, for which age and geographical effects were found. The frequency distribution of Zn levels was bimodal. The second peak in the distribution appeared to be related to elevated levels of Cu. The average level of Cu was 104 mg/kg (dry wt), higher than in other marine mammals. Average levels of Cd were significantly higher in the eastern zones, but were always <1.0 mg/kg (dry wt), significantly lower than in their prey species. Mercury levels tended to be higher in the western zones bordering the Beaufort Sea. Mean Hg levels ranged from 20 mg/kg in the eastern zones to 70 mg/kg in the western zones. Levels of Hg in the eastern zones were related to age by following expression: Hg (mg/kg dry wt) = 15.7 + 8.0 Age (yr). Hg levels in the most northerly zone, near Melville Island, were very high, 18.4 + 27.5 Age mg/kg (dry wt). Levels of Hg and Se were very highly correlated, with a molar ratio of 1.27:1, Hg:Se. (Author's abstract)
W87-06395

TRACE ELEMENTS IN PRECIPITATION OVER AN INDUSTRIAL AREA OF BOMBAY,
Bhabha Atomic Research Centre, Bombay (India). Air Monitoring Section.
T. N. Mahadevan, V. Meenakshy, and U. C. Mishra.
The Science of the Total Environment STENDL, Vol. 48, No. 3, p 213-221, February 1986. 2 fig, 5 tab, 20 ref.

Descriptors: *Path of pollutants, *Water pollution sources, *Acid rain, *Chemistry of precipitation, *Trace elements, *Bombay, *Aerosols, Arsenic, Mercury, Zinc, Antimony, Chromium, Cobalt, Rain, Industrial areas.

An extensive rainwater sampling program was carried out in the Chembur Trombay industrial belt of Bombay (India) to assess the elemental composition of precipitation. Analytes included Hg, Cr, Sb, Pa, Fe, Sc, Sm, La, Eu, As, Co, Zn, Na, K, Ca, Mg, Br, and Cl originating from marine, crustal, and industrial sources. For comparison, their concentrations at a non-polluted coastal site (Alibag) also were studied. The elemental excesses were determined by calculating the enrichment factors with respect to Sc in the crust, and their probable sources were examined. Contributions of Na, Kg, Mg, Cl, and Br were mainly of marine origin. A loss of Br in monthly samples was observed. The Ca contribution from the industrial source was not carried over long distances as the mass median diameter of size-separated aerosols was about 4.7 micron. As, Hg, Zn, Sb, Cr, and, to a certain extent, Co are predominantly introduced into the environment from industrial sources. (Rochester-PTT)
W87-06396

EFFECT OF IRRIGATED AGRICULTURE ON GROUNDWATER,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
H. Bouwer.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 113, No. 1, p 4-13, February 1987. 1 fig, 1 tab, 17 ref.

Descriptors: *Path of pollutants, *Groundwater pollution, *Irrigation effects, *Agricultural chemicals, *Groundwater management, *Water quality control, *Vadose water, *Groundwater movement, *Percolation, *Deep percolation, Groundwater, Pollutants, Water pollution, Irrigation, Quality control, Percolation rates, Pesticides, Salts, Nitrates, Nonuniform flow, Organic carbon, Microbial degradation, Biodegradation, Mathematical equations.

The time it takes for deep percolation water from irrigated fields to reach underlying groundwater increases with decreasing particle size of the vadose zone material and increasing depth to groundwater. For average deep percolation rates, decades may be required before water joins the groundwater. Due to nonuniform irrigation applications and preferential flow, some deep percolation water will reach the groundwater much faster. Dissolved salts, nitrate, and pesticides are the chemicals in deep percolation water of main concern in groundwater pollution. Movement of pesticides may be retarded in the vadose zone, but degradation may also be slowed due to reduced organic carbon content and microbial activity at greater depths. Because of the large area of irrigated land in the world and the real potential for groundwater pollution, more research is necessary on downward movement of water and chemicals in the vadose zone. (Author's abstract)
W87-06409

EFFECT OF IRRIGATION OF GROUNDWATER QUALITY IN CALIFORNIA,
Schmidt (Kenneth D.), Fresno, CA.
K. D. Schmidt, and I. Sherman.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 113, No. 1, p 16-29, February 1987. 3 fig, 20 ref.

Descriptors: *Path of pollutants, *Groundwater pollution, *Irrigation effects, *Groundwater management, *Vadose water, *Groundwater, *Deep percolation, *Irrigation-return flow, *California, Irrigation, Water quality management, Pollutants, Agricultural chemicals, San Joaquin Valley, Sacramento Valley, Imperial Valley, Los Angeles Basin, Tile drainage, Drainage, Soil types, Nitrates, Salinity, Chemical properties, Pesticides, Valleys, Water quality.

Deep percolation of irrigated return flow is a major source of recharge beneath most irrigated areas in California. Tile drainage, soils, water in the vadose zone, and shallow groundwater were studied. Nitrate, salinity, and several pesticides received the most attention. Numerous parts of the San Joaquin Valley were investigated, as well as parts of the Sacramento Valley, Imperial Valley, Los Angeles Basin, and several other valleys. The results indicate that irrigation return flow usually exerts a substantial impact on groundwater quality. High nitrate contents in groundwater beneath irrigated areas are often the result of irrigation. In addition, extensive pollution of shallow groundwater in parts of the San Joaquin Valley was caused by use of the pesticide DBCP. (Author's abstract)
W87-06410

IRRIGATION EFFECTS IN ARIZONA AND NEW MEXICO, BY G. V. SABOL,
G. V. Sabol, H. Bouwer, and P. J. Wierenga.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 113, No. 1, p 30-48, February 1987. 1 fig, 7 tab, 22 ref.

Descriptors: *Path of pollutants, *Groundwater pollution, *Irrigation effects, *Groundwater management, *Groundwater, *Arizona, *New Mexico, *Groundwater recharge, *Aquifers, Agricultural chemicals, Pollutants, Water quality management, Agriculture, Irrigation, Water quality, Groundwater irrigation, Irrigation-return flow, Deep percolation, Percolation, Field tests, Recharge, Surface water, Fertilizers, Pesticides, Perched water, Saline soils.

Irrigated agriculture accounts for about 90% of all water consumption in both Arizona and New Mexico. More than 50% of this water is pumped from groundwater sources. Some portion of the applied irrigation water is returned to the groundwater supply through deep percolation. Several field studies were conducted in these states to measure the quantity and quality of water that is recharging the aquifer. These studies indicate that groundwater quality in Arizona and New Mexico has been deleteriously affected in deep aquifers and in shallow aquifers that are hydraulically connected to surface water supplies. The magnitude and time rate of groundwater quality changes is a func-

tion of irrigation management practice, fertilizer and pesticide applications, quality of irrigation water, rate of groundwater level decline, presence of perched zones that intercept percolating water, proximity to surface supplies, leakage through and along well casings, and soil salinity. (Author's abstract)
W87-06411

IRRIGATION EFFECTS IN OKLAHOMA AND TEXAS,
J. P. Law.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 113, No. 1, p 49-56, February 1987. 1 fig, 9 ref.

Descriptors: *Path of pollutants, *Groundwater pollution, *Irrigation effects, *Groundwater management, *Aquifers, *Groundwater, *Oklahoma, *Texas, *Deep percolation, Water quality management, Pollutants, Water quality, Drinking water, Irrigation, Salts, Nitrates, Irrigation efficiency, Fertilizers, Reviews.

Groundwater contamination is a serious water quality problem since 50% of the population derives drinking water from groundwater sources. Severe water quality problems have resulted from deep percolation under irrigated areas, carrying high salt loads and increased nitrate concentrations to groundwater aquifers. Studies dealing with the effect of deep percolation from irrigation on groundwater quality were reviewed. Recommendations are developed to minimize the undesirable effects of groundwater contamination by irrigated agriculture. Major among the conclusions is that improved and/or more efficient irrigation and fertilizer management practices are required to minimize the adverse impact of irrigated agriculture on the quality of underlying groundwater. When water and nutrient application and use efficiencies are improved, deep percolation is decreased and less downward movement of pollutants occurs. Structural improvements in irrigation systems are a necessary aid to achieving the desired level of management. (Author's abstract)
W87-06412

IRRIGATION EFFECTS IN SIX WESTERN STATES,
URS Corp., San Bernardino, CA.
M. B. Sonnen, J. L. Thomas, and J. C. Guitjens.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 113, No. 1, p 57-68, February 1987. 24 ref, append.

Descriptors: *Irrigation effects, *Irrigation, *Groundwater, *Groundwater management, *Western states, *Reviews, *Water pollution sources, *Groundwater pollution, Irrigation practices, Irrigation water, Idaho, Montana, Nevada, Oregon, Utah, Washington, Agriculture, Salts, Water quality.

Results of field and laboratory studies performed over the past 20 years in Idaho, Montana, Nevada, Oregon, Utah, and Washington are reviewed. The studies varied in number, intensity, and breadth from state to state, but none was able to demonstrate conclusively the effects that agricultural irrigation had or was having on the quality of underlying groundwater, the effects that were sought both by these reviewers and by the original investigators. It is concluded that sampling projects to determine these effects must follow rigorous salt balance investigation schemata, that such projects are and will be expensive and time-consuming, and that the state-of-the-art techniques for gleaning true knowledge about waters within the earth are still emerging. Nonetheless, the review also leads to the inescapable conclusion that western U.S. groundwater quality has deteriorated in many places, and agricultural irrigation practices are strongly implicated as contributing sources of that decline. (Author's abstract)
W87-06413

RA-226 CONCENTRATIONS IN OTTER, LUTRA CANADENSIS, TRAPPED NEAR URANIUM TAILINGS AT ELLIOT LAKE, ONTARIO,
Toronto Univ. (Ontario). Inst. for Environmental Studies.
C. D. Wren, N. R. Cloutier, T. P. Lim, and N. K. Dave.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 2, p 209-212, February 1987. 1 tab, 7 ref.

Descriptors: *Food chains, *Radioactive wastes, *Path of pollutants, *Fate of pollutants, *Environmental effects, *Radium-226, *Otters, *Uranium radioisotopes, *Mine wastes, *Elliot Lake, Uranium, Canada, Ontario, Fish, Shiner, Sucker, Benthic fauna, Aquatic animals, Radioisotopes, Lakes.

Exploitation of Uranium ores in Canada has produced large quantities of surface waste tailings near mine sites. The transfer and fate of uranium-series radionuclides, including Ra226, from the tailing sites are a major environmental concern, so Ra226 levels in otters (Lutra canadensis) were measured. Otters eat fish, clams, and crayfish, as well as some birds and small mammals. The fish consumed are primarily slower-moving bottom feeders, such as suckers and shiners, shown to accumulate the highest levels of Ra226. Clams and other benthic invertebrates were shown previously to accumulate significant levels of radionuclides. Therefore, wildlife species feeding on benthic aquatic organisms near tailing sites are potentially exposed to relatively high dietary Ra226 levels. Ra226 levels in the leg bones of 7 otters trapped in the Elliot Lake area ranged from < 0.1 to 12.6 pCi/g. (Wood-PTT)
W87-06421

DEPOSITION AND PERSISTENCE OF AERIALLY-APPLIED FENTHION IN A FLORIDA ESTUARY,
Harbor Branch Oceanographic Institution, Inc., Ft. Pierce, FL.
T. C. Wang, R. A. Lenahan, and J. W. Tucker.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 2, p 226-231, February 1987. 2 fig, 1 tab, 7 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Fenthion, *Estuaries, *Estuarine environment, *Insecticides, *Florida, Field tests, Pollutants, Salt marshes, Concentration time, Tidal effects, Tidal marshes.

Fenthion is one of the most commonly used mosquito insecticides in the state of Florida. Although not sprayed on water intentionally, aerially applied insecticides may accidentally drift into estuarine waters. The occurrence and persistence of fenthion was studied after four aerial sprays conducted between September 1984 and June 1985 over salt-marsh water. It was found that the highest peak concentration was 1.69 micrograms/l fenthion at 45 minutes after the spray. Concentration then decreased to a non-detectable level after 24 hours. Fenthion droplets deposited on the water surface dispersed immediately and were diluted in the water. Tidal flushing transported the insecticide in the water, playing an important role in the disappearance of fenthion. (Wood-PTT)
W87-06422

ORGANOCHLORINE INSECTICIDES IN TROUT, SALMO TRUTTA FARIO L., TAKEN FROM FOUR RIVERS IN LEON, SPAIN,
Universidad de Leon (Spain). Dept. of Biochemistry.
M. T. Teran, and M. Sierra.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 2, p 247-253, February 1987. 3 tab, 15 ref.

Descriptors: *Path of pollutants, *Pollutant identification, *Organochlorine pesticides, *Spain, *Rivers, *Trout, *Bioaccumulation, Insecticides, Pollutants, Fish, Gas chromatography, DDE, DDT, Tissue analysis.

Results of a 1986 survey of levels of ten organochlorine insecticides in the brain, lever, muscle and kidney samples of trout from four rivers in Spain were analyzed. Though there is no chemical industry or pesticide use in the locations studied, the levels of organochlorine pesticide contaminants were significant. Identification and quantification of the organochlorine residues were carried out by gas-chromatography. Quantitative measurement of the insecticide residues was accomplished by comparison of peak heights from standard solutions of alpha-HCH, lindane, heptachlor-epoxide, aldrin, dieldrin, endrin, ortho,para'-TDE, para,para'-TDE, para,para'-DDE, and para,para'-DDT (the sum of the residues of the last four is referred to as SDDT). The accumulation of SDDT in all samples was higher than the other pesticide residues found which is attributed to their high persistence in soils. From the observation of the accumulation rate of all organochlorine pollutants in the tissues studied, it was seen that residues were mainly accumulated in the brain and at a lower rate in the kidney. (Wood-PTT)
W87-06423

ORGANOCHLORINE LEVELS IN EDIBLE MARINE ORGANISMS FROM KUWAITI COASTAL WATERS,
International Lab. of Marine Radioactivity, Monaco-Ville (Monaco).
J. P. Villenueve, S. W. Fowler, and V. C. Anderlini.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 2, p 266-270, February 1987. 2 fig, 2 tab, 12 ref.

Descriptors: *Water pollution sources, *Organochlorine compounds, *Tissue analysis, *Path of pollutants, *Polychlorinated biphenyls, *Coastal waters, *Kuwait, DDE, DDT, DDD, Fish, Marine animals, Comparison studies, Mediterranean Sea, Adriatic Sea, Agricultural chemical, Industrial wastes, Organic compounds, Pesticides.

Although there are relatively few sources of organochlorine compounds within Kuwait, coastal waters and organisms are exposed to biocides and other organochlorine compounds used on agricultural land draining into the Shatt Al Arab delta, or those adsorbed on airborne particulates transported in the severe seasonal storms. Samples of different edible marine organisms collected from coastal waters between February and March of 1979 were analyzed for the polychlorinated biphenyls: para,para'-DDE, para,para'-DDD, and para,para'-DDT. Although the marine species contained measurable amounts of the compounds, the level of concentration was relatively low. Using PCBs as a marker, concentrations in fish from Kuwait and other Gulf areas were approximately an order of magnitude lower than those found in similar organisms from the Mediterranean Sea. The relative importance of DDE compared to PCBs was statistically similar in the Gulf region and in the Adriatic Sea which suggested that input source terms (agricultural and industrial) contain similar ratios of these compounds in both areas. (Wood-PTT)
W87-06424

MERCURY IN FLOUNDER, PLATICHTYS FLESUS, COD, GADUS MORHUA, AND PERCH, PERCA FLUVIATILIS, IN RELATION TO THEIR LENGTH AND ENVIRONMENT,
Fish Technology Inst. TNO, Ijmuiden (Netherlands).
J. B. Luten, W. Bouquet, G. Riekwel-Booy, A. B. Rauchbaar, and M. W. M. Scholte.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 2, p 318-323, February 1987. 4 fig, 1 tab, 11 ref.

Descriptors: *Path of pollutants, *Mercury, *Coastal waters, *Fish physiology, *Flounder, *Cod, *Perch, *Bioindicators, Heavy metals, Comparison studies, Fish, Pollutants, Netherlands, Tissue analysis.

Results from a few recent Dutch monitoring studies of mercury in flounder, cod, and perch are presented. A significant positive correlation was found between the mercury content in the muscle tissue of flounder from the Waddensea and the coastal water near the Western Scheldt and the length. The mercury content in the flounder from the Waddensea with a length of 20-40 cm was

significantly higher than that of the coastal fish. In the period from 1980-1982 the average dissolved mercury content in the Waddensea was approximately two times higher than that of the coastal waters. Subsequently, in 1983-1984 a decrease in the dissolved mercury content of the Waddensea was observed. Therefore, flounder from the Waddensea with an average age of 2-3 years (length > 26 cm) was exposed to a higher level of mercury than the corresponding flounder from the Western Scheldt coast. Similar positive correlations between length and mercury content were observed for cod and perch. It was concluded that for monitoring purposes, the relationship between the mercury content in the muscle tissues and the length of the fish has to be taken into account. However, it was also concluded that the mercury content in the fish does not always reflect the current state of pollution in the environment. (Wood-PTT)
W87-06426

SUBSURFACE TRANSPORT PROGRAM SUMMARY,
Department of Energy, Washington, DC. Office of Health and Environmental Research.
F. J. Wobber.
Report No. DOE/ER-0156/3, September 1985. 45 p, 4 fig, 1 tab, 11 ref, 3 append.

Descriptors: *Groundwater pollution, *Path of pollutants, *Fate of pollutants, *Solute transport, Organic compounds, Trace metals, Radionuclides, Research priorities.

Because natural processes associated with the release and the transport of organic compounds, trace metals, and radionuclides are incompletely understood, research in this area is critical if the long term scientific uncertainties about contaminant transport are to be resolved. The processes that control mobilization and attenuation of energy residuals in soils and geological strata, their hydrological transport to and within groundwater regimes, and their accumulation in biological systems require research attention. Scientific research in these areas will provide a base of knowledge from which long term or unexpected biological effects, if any, can be predicted and evaluated. DOE's core research program is summarized. It is designed to provide a base of fundamental scientific information so that the geochemical, hydrological, and biological mechanisms that contribute to the transport and long term fate of energy related contaminants in subsurface ecosystems can be understood. Developing a fundamental understanding of the physical and chemical mechanisms that control the transport of single and co-contaminants is the underlying concern of the program. (Lantz-PTT)
W87-06450

HEAVY METAL CONCENTRATION IN SLUDGE-SOIL SYSTEMS AS A RESULT OF WATER INFILTRATION,
Puerto Rico Univ., Mayaguez. Dept. of Chemical Engineering.
L. M. Ramirez, J. B. Rodriguez, and F. Barba.
IN: Symposium on Tropical Hydrology and 2nd Caribbean Islands Water Resources Congress, Proceedings of the International Symposium, May 5-8, 1985, San Juan, Puerto Rico. p 20-25, 3 fig, 2 tab, 14 ref.

Descriptors: *Heavy metals, *Path of pollutants, *Infiltration, *Puerto Rico, Solute transport, Soil contamination, Sludge, Waste disposal, Cadmium, Chromium, Simulation analysis, Computers.

Research was conducted at the University of Puerto Rico-Mayaguez to determine the distribution coefficients of heavy metals in two soils in Puerto Rico and to predict some heavy metal concentration through soil due to land application of sludge. The experimental work was divided into two main parts: batch experiments by which the distribution coefficients of the sludge-soil system were determined, and soil column experiments to trace metal movement through the soil. The sludge produced by the Barceloneta Wastewater Treatment Plant was used in both experiments. The soils and sludge were analyzed for cadmium and chromium and mixed in various proportions. Results obtained from the soil column studies showed a tendency to an increase in the soil concentration of Cr with time. No measurable trace of Cd was found. The distribution coefficients were determined and used in the Lapidus-Amundson model transport equation to predict heavy metal concentrations through soils due to sludge application. The results obtained from a computer simulation of the application of sludge to soil showed that adsorption of the metal by the soil takes place and migration of the metals was predicted to be a very slow process. (See also W87-06455) (Author's abstract)
W87-06460

APPLICATION OF 222-RN IN MEASURING GROUNDWATER DISCHARGE TO THE MARTHA BRAE RIVER, JAMAICA,
Lamont-Doherty Geological Observatory, Palisades, NY.
For primary bibliographic entry see Field 2F.
W87-06468

MODELING OF SOLUTE TRANSPORT THROUGH GROUND-WATER SYSTEMS,
Dames and Moore, Golden, CO.
A. Prakash, and P. Sherlock.
IN: Symposium on Tropical Hydrology and 2nd Caribbean Islands Water Resources Congress, Proceedings of the International Symposium, May 5-8, 1985, San Juan, Puerto Rico. p 150-153, 1 fig, 5 ref.

Descriptors: *Model studies, *Groundwater movement, *Solute transport, *Path of pollutants, Mathematical models, Mathematical equations, Simulation analysis, Hydraulic properties, Conductivity, Porosity, Hydraulic head.

Analytical solutions to model the transport of miscible contaminants through groundwater systems are presented. Some of the sources of groundwater contamination include buried containers of industrial wastes; seepage from evaporation ponds, septic tanks, bogs, or irrigated fields; and injection wells used for the disposal of wastewater. Sophisticated finite-element and finite-dispersion of contaminants released in a groundwater system by transient or continuous sources. These models have been designed to simulate spatially varying hydraulic properties of the porous medium, e.g., hydraulic conductivity, porosity, dispersivity, saturated thickness, and hydraulic head. In most field situations, such detailed information is not available and the modeler is constrained to perform a preliminary conservative analysis assuming uniform flow in an isotropic homogeneous porous medium with invariant porosity, dispersivity, and saturated thickness. The simplified solutions presented are useful for such situations. These solutions include steady and non-steady-state transport of contaminants in rectangular and radial flow fields. (See also W87-06455) (Lantz-PTT)
W87-06486

SPATIAL AND TEMPORAL DISTRIBUTION OF SULFIDE AND REDUCED METALS IN THE TAILWATER OF NARROWS DAM (LAKE GREESON), ARKANSAS,
Ouachita Baptist Univ., Arkadelphia, AR. Dept. of Chemistry.
J. Nix.
Available from the National Technical Information Service, Springfield, VA. 22161. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS. Technical Report E-86-14, November 1986. Final Report. 103 p, 15 fig, 4 tab, 18 ref, 2 append.

Descriptors: *Path of pollutants, *Tailwater, *Aeration, *Narrows Dam, *Lake Greeson, *Arkansas, *Sulfides, *Heavy metals, Spatial distribution, Temporal distribution, Iron, Manganese, Reservoirs, Lakes.

Water quality problems in tailwater areas are frequently related to water quality conditions in the reservoir. Of particular concern are elevated concentrations of sulfide and reduced metals, such as iron and manganese. Field investigations at Narrows Dam (Lake Greeson), located on the Little Missouri River in southwest Arkansas, document temporal and spatial patterns in the distribution of sulfide and reduced metals within and below a hydropower reservoir. Laboratory experiments involving reaeration of anoxic hypolimnetic waters were conducted to evaluate factors influencing the oxidation of various reduced metals. These results are compared with field observations. (Author's abstract)
W87-06518

CE-QUAL-R1: A NUMERICAL ONE-DIMENSIONAL MODEL OF RESERVOIR WATER QUALITY: USER'S MANUAL.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 2H.
W87-06520

NAPHTHALENE BIODEGRADATION IN ENVIRONMENTAL MICROCOSMS: ESTIMATES OF DEGRADATION RATES AND CHARACTERIZATION OF METABOLITES,
National Center for Toxicological Research, Jefferson, AR.
M. A. Heitkamp, J. P. Freeman, and C. E. Cerniglia.
Applied and Environmental Microbiology AEMIDF, Vol. 53, No. 1, p 129-136, January 1987. 7 fig, 1 tab, 48 ref.

Descriptors: *Metabolites, *Fate of pollutants, *Pollutant identification, *Biodegradation, *Sediments, *Naphthalene, Degradation, Hydrocarbons, Microbiological studies, Agricultural chemicals, Ecological effects, Mineralization, Bacteria, Heterotrophic bacteria, Chromatography, Radioactivity, Thin layer chromatography, Gas chromatography, Mass spectrometry, Ecosystems, Arkansas, Texas, Population exposure.

Naphthalene biodegradation was investigated in microcosms containing sediment and water collected from three ecosystems, two of which were located in Arkansas and one in Texas, which varied in past exposure to anthropogenic and petrogenic chemicals. Mineralization half-lives for naphthalene in microcosms ranged from 2.4 weeks in sediment chronically exposed to petroleum hydrocarbons to 4.4 weeks in sediment from a pristine environment. Microbiological analysis of sediments indicated that hydrocarbon-utilizing microbial populations also varied among ecosystems and were 5 to 12 times greater in sediment after chronic petrogenic chemical exposure than in sediment from an uncontaminated ecosystem. Sediment from an ecosystem exposed to agricultural chemicals had a mineralization half-life of 3.2 weeks for naphthalene and showed about a 30-fold increase in heterotrophic bacterial populations in comparison to uncontaminated sediments, but only a 2- to 3-fold increase in hydrocarbon-degrading bacteria. Analysis of organic solvent-extractable residues from the microcosms by high-pressure liquid chromatography detected polar metabolites which accounted for 1 to 3% of the total radioactivity. Purification of these residues by thin-layer chromatography and further analysis by gas chromatography-mass spectrometry indicated that cis-1,2-dihydroxy-1,2-dihydronaphthalene, 1-naphthol, salicylic acid, and catechol were metabolites of naphthalene. These results provide useful estimates for the rates of naphthalene mineralization in different natural ecosystems and on the degradative pathway for microbial metabolism of naphthalene in freshwater and estuarine environments. (Author's abstract)
W87-06545

CARBON INTERRELATIONSHIPS IN A SMALL AQUATIC ECOSYSTEM,
Bucknell Univ., Lewisburg, PA. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W87-06556

STUDIES ON FOUR STREAMS ENTERING TOLO HARBOUR, HONG KONG IN RELA-

TION TO THEIR IMPACT ON MARINE WATER QUALITY,
Hong Kong Univ. Dept. of Botany.
I. J. Hodgkiss, and B. S. S. Chan.
Archiv fuer Hydrobiologie AHYBA4, Vol. 108, No. 2, p 185-212, December 1986. 14 fig, 7 tab, 37 ref.

Descriptors: *Streams, *Tolo Harbor, *Self-purification, *Water pollution control, *Harbors, *Water pollution sources, *Hong Kong, Eutrophication, Farm wastes, Turbidity, Chlorophyll, Water quality standards, Coliforms, Nitrogen, Phosphorus, Pollution load.

Tolo Harbor, a nearly land-locked sea inlet in Hong Kong, 52 sq miles in size, has reached a stage where pollution loading exceeds receptive capacity. The major sources of this load are the streams entering the harbor. Three of the four major streams investigated were badly polluted by organic matter as seen from their turbidity, nitrogen and orthophosphate phosphorus loading, their BOD values and bacterial content. The major source of this organic matter is human sewage, with agricultural animal wastes also contributing importantly. The possibility of self purification is dubious given the short lengths of the rivers and the degree of human influence. Unless measures are taken to reduce the organic loading of these streams, conditions in Tolo Harbor will further deteriorate. Data for the study was collected bimonthly for fourteen months. (Author's abstract)
W87-06558

COMPARISON OF SOME PHYSICOCHEMICAL PARAMETERS OF HUMIC SUBSTANCES ISOLATED FROM THREE DIFFERENT AQUATIC ECOSYSTEMS,
Polish Academy of Sciences, Poznan. Dept. of Agrobiology and Forestry.
For primary bibliographic entry see Field 5A.
W87-06561

SOME EUROPEAN PERSPECTIVES ON PREVENTION OF LEAKS FROM UNDERGROUND PETROLEUM STORAGE SYSTEMS,
M. Moreau.
Ground Water Monitoring Review GWMRDU, Vol. 7, No. 1, p 45-48, Winter 1987. 5 fig.

Descriptors: *Water pollution sources, *Groundwater pollution, *Design standards, *Storage tanks, Petroleum products, Coatings, Europe, Regulations, Testing procedures, Enivironmental protection, Asphalt, Epoxy resins, Gasoline.

The threat posed to groundwater resources by leaking underground petroleum storage tanks has only recently been recognized in the U.S., whereas several European countries have, over the past 20 years, developed practical experience in effective prevention of such leaks. The author briefly surveys the current tank installation practices and regulatory requirements in West Germany, France, the Netherlands, and England. Tank standards, piping, pumps, and overfill protection are discussed for each country. There is no single 'European' approach to underground petroleum storage. However, storage standards are uniform within a country, regardless of ownership or use of the storage facility. Fiberglass tanks are not much used in Europe. In the countries for which information is available (Germany and France), pressure standards for tanks are 29.4 and 44 psi respectively (tanks in the U.S. are built to withstand 5 psi). The use of asphalt as a tank coating is common except in France, where epoxy is used. Domed-end tanks are the standard in Germany and France. (Airone-PTT)
W87-06568

VACUUM AND PRESSURE TEST METHODS FOR ESTIMATING HYDRAULIC CONDUCTIVITY,
NUS Corp., Pittsburgh, PA. Cyrus Wm. Rice Div.
For primary bibliographic entry see Field 2F.
W87-06569

SUBSURFACE VENTING OF VAPORS EMANATING FROM HYDROCARBON PRODUCT ON GROUND WATER,
Radian Corp., Austin, TX.
W. L. Crow, E. P. Anderson, and E. M. Minugh.
Ground Water Monitoring Review GWMRDU, Vol. 7, No. 1, p 51-57, Winter 1987. 6 fig, 3 tab, 2 ref.

Descriptors: *Hydrocarbons, *Petroleum products, *Water pollution control, *Path of pollutants, *Venting, *Water pollution treatment, *Soil gases, *Groundwater pollution, Optimization, Accidents, Vadose water, Soil porosity, Performance evaluation.

The results of an API-sponsored pilot-scale subsurface venting system study are presented. The effectiveness of forced venting techniques in controlling and removing hydrocarbon vapors from a subsurface formation was evaluated. Both qualitative and quantitative sampling and analytical procedures were developed to measure hydrocarbon vapors extracted from the soil. Vapor recovery and equivalent liquid product recovery rates were measured at each test cell evacuation rate. Two identical test cells were installed. Each cell contained 16 vapor monitoring probes spaced at distances of from 4 to 44 feet from a vapor extraction (vacuum) well. Each cell was also configured with two air inlet wells to allow atmospheric air to enter the subsurface formation. The vapor monitoring probes were installed at three discrete elevations above the capillary zone. In situ vapor samples were obtained periodically from these probes measure changes in vapor concentration and composition while extracting vapors from the vacuum well at three different flow rates (18.5, 22.5, and 39.8 scfm). In situ vapor samples were analyzed using a portable gas chromatograph. Vacuum levels were also measured at each vapor sampling probe and at the vacuum well. The techniques evaluated here offer an alternative approach to controlling or eliminating spilled or leaked hydrocarbons from sand or gravel formations of high porosity and moderate permeability. These techniques may also augment conventional liquid recovery methods. The data collected will be useful in optimizing subsurface venting systems for removing and controlling hydrocarbon vapors in soil. The results indicate that pulsed venting techniques may offer a cost-effective means of controlling or eliminating hydrocarbon vapors in soil. (Author's abstract)
W87-06570

INTERPRETATION OF GAS CHROMATOGRAPHIC DATA IN SUBSURFACE HYDROCARBON INVESTIGATIONS,
Amoco Corp., Tulsa, OK.
For primary bibliographic entry see Field 5A.
W87-06571

NATURAL ATTENUATION OF AROMATIC HYDROCARBONS IN A SHALLOW SAND AQUIFER,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
J. F. Barker, G. C. Patrick, and D. Major.
Ground Water Monitoring Review GWMRDU, Vol. 7, No. 1, p 64-71, Winter 1987. 9 fig, 1 tab, 18 ref.

Descriptors: *Path of pollutants, *Groundwater pollution, *Petroleum products, *Sand aquifers, *Biodegradation, *Aromatic compounds, Migration, Sand, Biological oxygen demand, Kinetics.

Inadvertent release of petroleum products such as gasoline into the subsurface can initiate ground water contamination, particularly by the toxic, water soluble and mobile gasoline components, benzene, toluene, and the xylenes (BTX). To examine the processes controlling the rate of movement and the persistence of BTX in the aquifer, water containing about 7.6 g/l total BTX was introduced below the water table and the migration of contaminants through a sandy aquifer was monitored using a dense sampling network. BTX components migrated slightly slower than the ground water due to sorptive retardation. Essentially all the injected mass of BTX was lost within 434 days due to biodegradation. Rates of mass loss were similar for all monoaromatics; benzene was the only component to persist beyond 270 days. Laboratory biodegradation experiments produced similar rates, even when initial BTX concentration varied. Exerting control over BTX biodegradation was the availability of dissolved oxygen. Decreasing mass loss rates over time observed in the field experiment are not likely due to first-order degradation rates, but rather to the persistence of small fractions of BTX mass in anoxic layers. (Author's abstract)
W87-06572

PRACTICAL APPLICATION OF MULTIPHASE TRANSPORT THEORY TO GROUND WATER CONTAMINATION PROBLEMS,
EA Engineering, Science, and Technology, Inc., Lafayette, CA.
R. E. Hinchee, and H. J. Reisinger.
Ground Water Monitoring Review GWMRDU, Vol. 7, No. 1, p 84-92, Winter 1987. 7 fig, 4 tab, 8 ref.

Descriptors: *Soil physical properties, *Hydrocarbons, *Path of pollution, *Transport, *Groundwater pollution, Soil gases, Gasoline, Seepage, Petroleum products, Physicochemical properties, Theoretical analysis, Aromatic compounds, Subsurface water, Distribution.

Subsurface hydrocarbon transport is a complex problem. Typically, hydrocarbons introduced into ground water systems are a mixture of compounds, each with unique physicochemical properties. Depending on the nature of both the site and the hydrocarbons, contaminant transport may take place in the bulk liquid hydrocarbon, ground water, or the vapor phase. It is possible, through examination of the distribution of hydrocarbons, coupled with a knowledge of their physicochemical properties to determine the predominant transport mechanisms operating on a site. An understanding of the transport mechanisms is of tremendous importance in contamination assessment, source identification, prediction of contaminant fate and transport, and effective design of remedial actions. A brief description of transport theory is included, and two case histories illustrate its application. (Airone-PTT)
W87-06575

EXAMINATION OF THE FATE OF NIGERIAN CRUDE OIL IN SURFACE SEDIMENTS OF THE HUMBER ESTUARY BY GAS CHROMATOGRAPHY AND GAS CHROMATOGRAPHY-MASS SPECTROMETRY,
Newcastle upon Tyne Univ. (England). Organic Geochemistry Unit.
D. M. Jones, S. J. Rowland, and A. G. Douglas.
International Journal of Environmental Analytical Chemistry IJEAA9, Vol. 24, No. 3, p 227-247, 1986. 6 fig, 3 tab, 34 ref.

Descriptors: *Fate of pollutants, *Estuaries, *Crude oil, *Surface sediments, *Gas chromatography, *Mass spectrometry, *Biodegradation, Hydrocarbons, Oil spills, Estuarian sediments, Intertidal sediments, Sediment cores, Tracers, Sandy sediments.

The hydrocarbon composition of surface sediment at two lithologically different sites in the Humber Estuary were examined by gas chromatography and gas chromatography-mass spectrometry. Laboratory biodegradation studies were carried out using a method which involved the addition of crude oil to a fresh surface sediment-seawater slurry. The sediments were sampled 5, 7, and 12 months after the accidental spillage of 6000 tons of a Nigerian light crude oil into the estuary from the tanker Sivand. The occurrence of distinctive marker compounds in the Nigerian oil faciliated the identification of residues of the ship's cargo in the sediments up to 12 months after the spill. Chromatograms revealed several other sources of hydrocarbon contribution to the sediments including those from algae, higher plants and fossil fuel combustion products. Field observations and laboratory studies indicated that the latter compounds

were less readily biodegraded in sediments than the oil-derived hydrocarbons. (Author's abstract)
W87-06590

FATE OF ATRAZINE AND TRIFLURALIN FROM AN INDUSTRIAL WASTE DUMPING AT THE LLOBREGAT RIVER. PRESENCE IN FISH, RAW AND FINISHED WATER,
Instituto de Quimica Bio-Organica, Barcelona (Spain).
J. Rivera, J. Caixach, M. De Torres, and F. Ventura.
International Journal of Analytical Chemistry IJEAA9, Vol. 24, No. 3, p 183-191, 1986. 5 fig, 1 tab, 11 ref.

Descriptors: *Fishkill, *Fate of pollutants, *Pollutant identification, *Atrazine, *Trifluraline, *Industrial wastewater, *Llobregat River, *Barcelona, Fish, Herbicides, Gas chromatography, Mass spectroscopy, Tissue analysis, Pesticides, Raw water, Carp, Wastewater, Organic compounds.

Analysis carried out after fish mortality in an industrial area in the neighborhood of the Llobregat River, water supplier for Barcelona and its area identified two herbicides, atrazine and trifluralin, in the industrial sewage wastewaters from various factories, one at least of which manufactured pesticides. The fate of these herbicides is followed in fish (dorsal muscle), raw water entering the water works plant and tap water. Analyses by GC, GC MS DS and mass fragmentography were employed. Other compounds detected were dodecylbenzenes, nonylphenols, and nonylphenolmonoethoxylates. Qualitative analyses of liver and dorsal muscle of dead carps led us to identify trifluralin as well as nonylphenols and nonylphenolmonoethoxylates in the dorsal muscle. Atrazine and trifluaralin were identified in extracts of raw water. (Author's abstract)
W87-06592

SULFUR CONSTITUENTS IN SOILS AND STREAMS OF A WATERSHED IN THE ROCKY MOUNTAINS OF ALBERTA,
State Univ. of New York Coll. of Environmental Science and Forestry, Syracuse.
M. J. Mitchell, M. B. David, D. G. Maynard, and S. A. Telang.
Canadian Journal of Forest Research CJFRAR, Vol. 16, No. 2, p 315-320, April 1986. 2 fig, 3 tab, 36 ref.

Descriptors: *Sulfur, *Streams, *Rocky Mountains watersheds, *Path of pollutants, *Organic sulfur, *Sulfur compounds, *Sulfates, *Alberta, Canada, *Marmot Basin, Soils, Ion chromatography, Atomic emission spectrophotometry, Carbon-bonded sulfur, Ester sulfate, Calcium, Magnesium, Carbon, Mineral weathering, Forest ecosystems.

The importance of organic and inorganic sulfur constituents in a mountain watershed in Alberta was ascertained, and whether organic sulfur is transferred through streams was determined. Phosphate extractable and water extractable sulfate were obtained by shaking the soil for 1 h in a 10:1 solution to soil ratio with either phosphate or deionized water, respectively. Solution sulfate was determined using an ion chromatograph. Nonsulfate inorganic sulfur was assayed by Zn-HCl reduction. In water samples, sulfate was determined using an ion chromatograph with an anion suppressor column. Total S, Ca, and Mg in the water samples was determined by vacuum inductively coupled plasma atomic emission spectrometer. Total S in soils ranged from 2.5 to 49.8 micromol/g dry mass; carbon-bonded S and ester sulfate were the dominant S constituents, with sulfate ranging from 0.1 to 8.1% of total S. Organic S was 12-21% of total S in stream waters. High concentrations of sulfate, Ca, Mg, and C in streams were due to mineral weathering. Atmospheric inputs of S at Marmot Creek were much less important than in forest ecosystems subject to acidic deposition. A tentative budget demonstrated the importance of weathering and organic S in this watershed. Analysis of one tributary along an elevation gradient indicated that a portion of the sulfate was retained within the terrestrial portion of the ecosystem in organic forms. The dynamics of these organic S constituents exert a major influence on S flux in some forest ecosystems as a result of their role in mineralization and immobilization processes. (Author's abstract)
W87-06601

5C. Effects Of Pollution

EFFECTS OF CADMIUM ON THE LIFE CYCLE OF ASELLUS AQUATICUS (L.) AND PROASELLUS COXALIS DOLLF. (CRUSTACEA, ISOPODA),
Naples Univ. (Italy). Dipt. Genetica, Biologia Generale e Molecolare.
M. de Nicola Giudici, L. Migliore, and S. M. Guarino.
Environmental Technology Letters ETLEDB, Vol. 7, No. 1, p 45-54, January 1986. 4 fig, 4 tab, 16 ref.

Descriptors: *Water pollution effects, *Crustaceans, *Isopods, *Cadmium, *Toxicity, Life cycles, Aquatic ecosystems, Population exposure, Sublethal levels, Alkalinity, Heavy metals.

The effects of Cd(2+) on Asellus aquaticus and Proasellus coxalis were studied in static tests, conducted separately on females, males, and juveniles. ST50 (survival of 50% of test individuals) comparisons indicated sensitivity differences in the two species and respectively among females, males, and juveniles. Juveniles born from parents bred in sublethal Cd(2+) concentrations had greater sensitivity than their parents. Water hardness was ineffective on Cd(2+) tolerance. The importance of determining the toxicity of a pollutant on different stages of the life cycle and on subsequent generations in evaluating the poisoning effects on an ecosystem is discussed. (Author's abstract)
W87-05939

EVALUATION OF THE SENSITIVITY OF MARINE HETEROTROPHIC BACTERIA TO ZINC AND CADMIUM BY THE ANTIBIOGRAM METHOD. ANALYSIS OF THE CONCORDANCE BETWEEN MINIMAL INHIBITORY CONCENTRATIONS AND INHIBITION ZONES ON SOLID MEDIUM (MESURE DE LA SENSIBILITE DES BACTERIES MARINES HETEROTROPHES AU ZINC ET AU CADMIUM PAR LA METHODE DE L'ANTIBIOGRAMME. ANALYSE DE LA CONCORDANCE ENTRE LES CONCENTRATIONS MINIMALE INHIBITRICES ET LES ZONES D'INHIBITION SUR MILIEU SOLIDE),
Institut National de la Sante et de la Recherche Medicale, Paris (France).
M. J. Gauthier, J. P. Breittmayer, V. A. Breittmayer, R. L. Clement, and G. N. Flatau.
Environmental Technology Letters ETLEDB, Vol. 7, No. 6, p 335-340, June 1986. 2 fig, 5 tab, 16 ref.

Descriptors: *Water pollution effects, *Bioindicators, *Sensitivity, *Bioassay, *Zinc, *Cadmium, *Antibiogram method, *Toxicity, *Marine bacteria, Bacterial physiology, Bacterial analysis, Heavy metals, Cultures.

Sensitivity of bacteria to heavy metals can be estimated by diffusion in solid media or dilution in liquid or solid media. Antibiograms can only be used for metals if well standardized and grounded on the knowledge of the concordance between inhibitory zones and minimal inhibitory concentrations measured in liquid media. This concordance was analyzed for Cd and Zn, with several marine bacteria. It largely depends on whether the inhibitory zones were read. The relationship between the minimal inhibitory concentration and width of the inhibition zones was log-linear for both metals. A semi-quantitative scheme is proposed for interpreting antibiograms, using cellulose disks in defined cultural conditions. (Author's abstract)
W87-05955

ENVIRONMENTAL IMPACTS OF SEWAGE SLUDGE APPLIED TO CROPLAND,
National Inst. for Environmental Studies, Tsukuba (Japan).
For primary bibliographic entry see Field 5E.
W87-05989

SUCCESSION THEORY, EUTROPHICATION, AND WATER QUALITY MANAGEMENT,
Loyola Univ. of Chicago, IL. Dept. of Natural Science.
For primary bibliographic entry see Field 2H.
W87-05994

PHYSICO-CHEMICAL CONDITIONS OF WATER IN THE RIVER KSHIPRA (INDIA) TO DETERMINE FISH PRODUCTIVITY,
Vikram Univ., Ujjain (India). School of Studies in Zoology.
A. B. Saxena, and R. Sehgal.
International Journal of Environmental Studies IJEVAW, Vol. 28, No. 2/3, p 179-196, 1986. 13 fig, 21 ref.

Descriptors: *Physicochemical properties, *India, *Fish management, *Rivers, *Productivity, *Stream fisheries, *Water pollution effects, Populations, Fish populations, Fisheries, Oxygen, Dissolved oxygen, Biological oxygen demand, Chemical oxygen demand, Carbon dioxide, Trace elements, Distribution, Temporal distribution, Monsoons, Wastewater, Industrial wastewater, Temperature, Turbidity, Physical properties, Chemical properties.

Physicochemical conditions at six sampling stations on the river Kshipra (India) were analyzed at monthly intervals to evaluate changes in the water quality relevant to fish productivity. Temperature, dissolved oxygen (DO), biological oxygen demand (BOD), chemical oxygen demand (COD), turbidity, total solids, total alkalinity, phenolphthalein alkalinity, chloride, total hardness, calcium, magnesium, and pH were measured. Water quality showed a considerable change throughout the year, indicating the productivity level of aquatic organisms. Data for DO, BOD, COD, dissolved CO_2, and trace elements like Ca and Mg indicate an appreciable fall in productivity during the summer, related to a decrease in fish production and availability of fish seed during the monsoon period. Studies reveal that the decrease in productivity is mainly due to pollutants brought through sewage and industrial discharge from the river Khan mixing with the river water. (Author's abstract)
W87-05997

RESPONSE OF AQUATIC VEGETATION TO SEDIMENTATION DOWNSTREAM FROM RIVER CHANNELISATION WORKS IN ENGLAND AND WALES,
Freshwater Biological Association, Wareham (England). River Lab.
For primary bibliographic entry see Field 5G.
W87-06002

ROLE OF SALINITY IN THE DEVELOPMENT OF PHYTOPHTHORA ROOT ROT OF CITRUS,
California Univ., Davis. Dept. of Vegetable Crops.
N. S. Blaker, and J. D. MacDonald.
Phytopathology PHYTAJ, Vol. 76, No. 10, p 970-975, October 1986. 4 fig, 2 tab, 27 ref.

Descriptors: *Salinity, *Plant pathology, *Citrus fruits, *Plant diseases, *Water pollution effects, *Phytophthora, *Fungi, *Root growth, Pathology, Diseases, Seedlings, Culturing techniques, Growth, Plant physiology, Irrigation effects.

A field survey of the Coachella Valley, CA indicated that root rot of citrus, caused by Phytophthora parasitica, increased with increasing soil salinity. When rootstock seedlings were grown hydroponically in the greenhouse and exposed briefly to high levels of salinity (EC = 22 dS/m) before inoculation, those of the sweet orange cultivar Pineapple were predisposed to severe root rot, whereas those of the citrange cultivar Troyer were

unaffected. However, Troyer seedlings grown for nine weeks in soil salinized to an electrical conductivity of 3-4 dS/m and infested with P. parasitica had 30% of their total root length decayed by Phytophthora, whereas plants in infested nonsaline soil showed only 10% decay. Similar results were obtained with Pineapple sweet orange seedlings at even lower levels of soil salinity. Total root growth and production of new roots by Troyer seedlings was greatly inhibited in saline soil. The results suggest that reduced root growth, as well as predisposition, may contribute to the severe root rot observed under saline field conditions. (Author's abstract)
W87-06010

SIGNIFICANCE OF THE TAURINE-GLYCINE RATIO AS AN INDICATOR OF STRESS,
Kiel Univ. (Germany, F.R.). Inst. fuer Meereskunde.
For primary bibliographic entry see Field 5A.
W87-06023

EFFECTS OF CHOLINESTERASES OF RAINBOW TROUT EXPOSED TO ACEPHATE AND METHAMIDOPHOS,
California Univ., Davis. Dept. of Clinical Pathology.
J. G. Zinkl, P. J. Shea, R. J. Nakamoto, and J. Callman.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 1, p 22-28, January 1987. 2 fig, 3 tab, 14 ref.

Descriptors: *Enzymes, *Fish physiology, *Pesticide toxicity, *Water pollution effects, *Acephate, *Trout, Organophosphorus pesticides, Toxicity, Pesticides, Fish, Insecticides, Tissue analysis, Chromatography, Animal physiology, Population exposure, Sublethal effects, Survival.

The effect of various concentrations of acephate on brain cholinesterase (ChE) was studied in rainbow trout. Similar information was obtained for methamidophos because of the possibility for acephate to be deacylated to form that compound. Brain ChE was found to be depressed (38.2%) in trout exposed for 24 hours to 400 mg/l acephate, but not significantly in trout exposed to 100 mg/l. After 24 hours in uncontaminated water, brain ChE was still depressed in the 400 mg/l trout. Plasma ChE was depressed in both groups of trout even after being in uncontaminated water for 24 hours. Liver and brain concentrations of acephate were higher in trout killed immediately after exposure than in those killed after 24 hours in uncontaminated water, except in the brains of the 400 mg/l fish. Brain ChE activity remained depressed for eight days after 24 hours of exposure to 25 mg/l methamidophos and for 15 days after 24 hours of exposure to 400 mg/l. It is concluded that the level of depression that suggests poisoning by either compound studies is greater than 70%, since both compounds inhibited brain ChE at least this much in some trout even though no trout died. However, the persistent ChE depression suggests that sublethal effects may occur, causing death indirectly. (See also W87-06025) (Doria-PTT)
W87-06024

BRAIN CHOLINESTERASE ACTIVITY OF RAINBOW TROUT POISONED BY CARBARYL,
California Univ., Davis. Dept. of Clinical Pathology.
J. G. Zinkl, P. J. Shea, R. J. Nakamoto, and J. Callman.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 1, p 29-35, January 1987. 1 fig, 2 tab, 16 ref.

Descriptors: *Enzymes, *Fish physiology, *Trout, *Pesticide toxicity, *Carbaryl, *Water pollution effects, Toxicity, Carbamate pesticides, Insecticides, Chromatography, Tissue analysis, Fish, Animal physiology, Population exposure, Bioindicators.

The toxicity of carbaryl to rainbow trout was studied, with particular attention to brain cholinesterase (ChE) depression. All fish exposed to carbaryl in the LC50 test had depressed brain ChE activities. Minimum depression in a trout that died was 61%, and most fish that died had brain ChE depression greater than 85%. Fish exposed to the highest concentrations of carbaryl exhibited the greatest brain ChE depression. Significant depression was present up to 24 hours after exposure ended. Concentrations of carbaryl in the livers of the trout exposed for 24 hours to various levels of carbaryl ranged from 0.10 to 0.26 micrograms/g. Concentrations in the brain were 0.10 to 0.63 micrograms/g; the fish exposed to the higher concentrations had the lowest brain residues. It is concluded that brain ChE activity can be used to diagnose poisoning of trout by carbaryl. Since brain ChE activity returns to normal within 48 hours after exposure, monitoring of fish in field applications should be conducted soon after carbaryl application. (See also W87-06024) (Doria-PTT)
W87-06025

EFFECTS OF ALDICARB ON THE BLOOD AND TISSUES OF A FRESHWATER FISH,
Kumaun Univ., Naini Tal (India). Dept. of Zoology.
J. Pant, H. Tewari, and T. S. Gill.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 1, p 36-41, January 1987. 1 tab, 23 ref.

Descriptors: *Aldicarb, *Water pollution effects, *Pesticide toxicity, *Carbamate pesticides, *Blood, *Fish physiology, *Tissue analysis, Fish, Toxicity, Pesticides, Insecticides, Animal physiology, Population exposure.

Changes in the hematological and biochemical profile were studied in a freshwater fish (Barbus conchonius) exposed chronically to a commercial formulation of aldicarb. Results showed moderate polycythemia (35.3 and 15.2% increase over controls) together with a rise in hemoglobin (Hb) content. The hematocrit (Hct) showed 27.7 and 29.1% increase over control values after 15 and 30 days, respectively. It is concluded that hypoxemia may trigger an exodus of erythrocytes from the hemopoietic loci in an attempt to compensate for the reduced oxygen-carrying capacity of the blood. A marked influence was also detected on the body lipid profile. A significant hypercholesterolemia occurred after both 15 and 30 days of exposure, although the increase in liver and ovary cholesterol was more pronounced at 15 days. (Doria-PTT)
W87-06026

ACUTE TOXICITY OF NITROFURAZONE TO CHANNEL CATFISH, ICTALURUS PUNCTATUS, AND GOLDFISH, CARASSIUS AURATUS,
Auburn Univ., AL. Dept. of Fisheries and Allied Aquacultures.
M. L. Wise, C. L. Stiebel, and J. M. Grizzle.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 1, p 42-46, January 1987. 2 fig, 10 ref.

Descriptors: *Toxicity, *Catfish, *Fish physiology, *Goldfish, *Nitrofurazone, *Water pollution effects, Drugs, Mortality, Tissue analysis, Fish diseases, Population exposure.

The acute toxicity of nitrofurazone, a compound found to be effective against external and internal infections of fish, was tested on channel catfish and goldfish fingerlings. LC50 values for catfish ranged from 84 mg/l for four hours to 19 mg/l for 48 hours; the 48-hour LC01 was 13.5 mg/l. LC50 values for goldfish ranged from 178 mg/l for seven hours to 71 mg/l for 96 hours; the 48-hour LC01 was 48.4 mg/l. Inflammation was evident in the epidermis of catfish exposed to 17 mg/l for 48 hours. After 100 hours, there was focal epidermal necrosis, and alarm substance cells were atrophied or missing. The musculature was edematous and the muscle cell nuclei were enlarged. Treated goldfish dying during the first 48 hours of exposure had more mucus on their gills than did controls. Hydropic degeneration and partial detachment of pharyngeal epithelium and edema of the gill lamellae occurred in some specimens, although no skin lesions were apparent. It is concluded that therapeutic levels of nitrofurazone (5-10 mg/l) would be safe for channel catfish even under the low dissolved oxygen conditions used in the tests; goldfish can tolerate much higher concentrations. (Doria-PTT)
W87-06027

DIET AND REPRODUCTIVE SUCCESS OF BLUEGILL RECOVERED FROM EXPERIMENTAL PONDS TREATED WITH ATRAZINE,
Kansas Univ., Lawrence. Experimental and Applied Ecology Program.
W. D. Kettle, F. deNoyelles, B. D. Heacock, and A. M. Kadoum.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 1, p 47-52, January 1987. 3 tab, 15 ref. EPA Project R806641010 and Kansas Water Resources Research Inst. Project A-092-KAN.

Descriptors: *Water pollution effects, *Pesticide toxicity, *Bluegills, *Atrazine, *Diets, *Herbicides, *Fish physiology, Ecological effects, Toxicity, Pesticides, Fish, Reproduction, Population exposure, Macrophytes, Ponds, Photosynthesis, Predation.

The effects of atrazine on macrophyte and bluegill sunfish populations were studied in experimental ponds at the Nelson Environmental Study area near Lawrence, KS. Aquatic communities were exposed to a commercial formulation of atrazine at active ingredient concentrations of 20 micrograms/l, 500 micrograms/l, and zero. The number of young retrieved from atrazine treated ponds was significantly less than from control ponds. Bluegill from control ponds had significantly more prey items in their stomachs than fish from treated ponds, with control pond fish averaging 25.6 food items per stomach compared to 3.8 and 5.7 for fish from 20 and 500 micrograms/l treatments, respectively. Moreover, food items in control pond fish stomachs represented a significantly greater number of taxomonic groups. The macrophyte community in treated ponds was noticeably reduced relative to controls throughout the summer; relative to control ponds, 20 micrograms/l ponds had a 90% reduction in macrophyte coverage and 500 micrograms/l ponds had a $> 95\%$ reduction. Treated ponds also had fewer species of macrophytes. These responses are from both direct and indirect effects of atrazine on pond ecosystems. It is concluded that macrophyte communities were directly affected through inhibition of photosynthesis, while bluegill young suffered from the effects of the resultant depauperate diet. (Doria-PTT)
W87-06028

POLYCYCLIC AROMATIC HYDROCARBON METABOLISM IN MULLETS, CHELON LABROSUS, TREATED BY POLYCHLORINATED BIPHENYLS,
Bordeaux-1 Univ., Talence (France). Lab. of Food Toxicology.
For primary bibliographic entry see Field 5B.
W87-06029

HEMATOLOGICAL EVALUATION OF LEAD INTOXICATION IN MALLARDS,
Florida Univ., Gainesville. Dept. of Physiological Sciences.
M. Mautino, and J. U. Bell.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 1, p 78-85, January 1987. 3 fig, 1 tab, 20 ref.

Descriptors: *Water pollution effects, *Bioindicators, *Lead, *Mallards, *Waterfowl, *Animal physiology, *Toxicity, Birds, Heavy metals, Enzymes, Tissue analysis, Bioaccumulation, Blood, Accumulation, Population exposure.

Critic..l biochemical alterations resulting from lead exposure are investigated in the mallard duck to evaluate their usefulness as indicators of environ-

mental lead exposure. The activity of delta-aminolevulinic acid dehydratase (delta-ALAD) was found to be maximally inhibited in lead-dosed mallards at one week after dosing, gradually returning to near normal levels after seven weeks. The log of delta-ALAD activity was inversely correlated with blood lead concentration. However, delta-ALAD is inhibited to a low and constant level when blood lead is equal to or greater than 0.02 micro-M, so elevated blood lead concentrations beyond this threshold cannot be distinguished. Increases in free erythrocyte protoporphyrin (FEP) concentrations became significant when lead concentration in mallard blood exceeds 2.90 micro-M, so that changes in this hematopoietic intermediate are much less sensitive to low levels of lead exposure. Blood concentrations of FEP in lead-dosed mallards was highest after one week, gradually decreasing to normal at five weeks. The log of FEP concentration showed a stronger (positive) correlation with blood lead concentration than did delta-ALAD. It is concluded that alterations in heme synthesis may provide a better indicator of toxic response to lead than measurements of blood or bone lead concentrations. (Doria-PTT)
W87-06032

EFFECT OF CADMIUM ON OVIPOSITION AND EGG VIABILITY IN CHIRONOMUS RIPARIUS (DIPTERA: CHIRONOMIDAE),
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
K. A. Williams, D. W. J. Green, D. Pascoe, and D. E. Gower.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 1, p 86-90, January 1987. 2 fig, 12 ref. EEC Grant ENV.773.UK.H.

Descriptors: *Reproduction, *Cadmium, *Water pollution effects, *Toxicity, *Bioindicators, *Midges, *Eggs, *Survival, *Insect behavior, Aquatic insects, Aquatic animals, Insects, Heavy metals, Behavior, Water quality, Water pollution, Population exposure, Cultures, Embryos.

The extent of selection by Chironomus riparius females between a range of cadmium solutions as sites for oviposition was investigated, along with the effect of cadmium on egg hatching. Newly emerged adult midges were collected from a laboratory culture and exposed to cadmium solutions at 0.3, 30, 100, and 300 mg/l. Higher numbers of egg ropes were laid in control and the two lower concentrations of cadmium than in solutions of 100 and 300 mg/l, indicating that female Chironomus discriminate between different concentrations of cadmium or some related physical/chemical parameter. However, it is concluded that their detection is relatively insensitive and would not lead to avoidance of solutions acutely toxic to early instar larvae. Exposure of egg ropes to cadmium after complete formation in control water had no effect on embryonic development, although exposure to cadmium of eggs separated from their gelatinous matrix reduced the percentage hatching from 80-100% to 60%. It is concluded that, while the egg stage is extremely resistant to cadmium toxicity, exposure during oviposition reduces and prevents complete development of embryos. (Doria-PTT)
W87-06033

COMPARATIVE TOXICOLOGICAL STUDY ON PIKE (ESOX LUCIUS L.) FROM THE RIVER RHINE AND RIVER LAHN,
Marburg Univ. (Germany, F.R.). Inst. of Toxicology and Pharmacology.
G. Koss, E. Schuler, B. Arndt, J. Seidel, and S. Seubert.
Aquatic Toxicology AQTODG, Vol. 8, No. 1, p 1-9, April 1986. 3 fig, 2 tab, 32 ref.

Descriptors: *Water pollution effects, *Organic compounds, *Heavy metals, *Pike, *Rhine River, *Lahn River, Pollutants, Fish, Rivers, Environmental effects, Morphology, Biochemistry, Halogens, Lead, Mercury, Copper, Zinc, Cadmium, Porphyrins, Distribution patterns, Enzymes, Tissue analysis, Comparison studies.

The influence of environmental pollutants on morphological and hepatic biochemical parameters of mature pike from the rivers Rhine and Lahn was investigated. Liver content of aromatic organohalogen compounds in Rhine pike was up to 40 times higher than found in pike from the Lahn. Lead and mercury residues in Rhine pike liver tissue were about twice as high as in Lahn pike. Copper and zinc contents were comparatively higher in Lahn pike. Cadmium occurred in about equal concentration in both groups. Interrelations between body weight and age, between body length and age, between body weight and body length, and between liver weight and body weight in both groups revealed no influence by xenobiotics. Distribution pattern of hepatic porphyrins in the Rhine pike differed significantly from that in the Lahn pike. The in vitro activity of the uroporphyrinogen decarboxylase of pike from the Rhine River was markedly lower than in pike from the Lahn River. (Author's abstract)
W87-06036

TOXICITY OF COPPER COMPLEXES TO THE MARINE DIATOM NITZSCHIA CLOSTERIUM,
Commonwealth Scientific and Industrial Research Organization, Sutherland (Australia). Div. of Energy Chemistry.
T. M. Florence, and J. L. Stauber.
Aquatic Toxicology AQTODG, Vol. 8, No. 1, p 11-26, April 1986. 9 tab, 46 ref.

Descriptors: *Water pollution effects, *Copper compounds, *Diatoms, *Toxicity, *Algal growth, *Photosynthesis, Pollutants, *Seawater, Algae, Ions, Proteins, Copper, Heavy metals, Enzymes, Oxidation.

Copper ions initially bind to Nitzschia with a stability constant, Beta sub 1, in the range log Beta sub $1 < 13 > 10$, a value which precludes sulfur bonding and suggests involvement of a membrane protein. Although the algal growth rate in sea water was halved by 20 micrograms Cu/l, photosynthesis was not affected until the copper concentration was above 100 micrograms Cu/l. This decoupling of growth and photosynthesis did not occur to the same extent with other algae species tested, and it is proposed that it results from an intracellular reaction between Cu(2+) and glutathione (GSH), leading to a lowering of the ratio of reduced to oxidized glutathione (GSH/GSSG) and suppression of mitosis. Water-soluble ligands generally decreased the toxicity of copper, whereas lipid-soluble copper complexes were highly toxic. Oxine, 2,9-dimethyl-1,10-phenanthroline, and pyridyl- and thiazolyl-hydroxyazo compounds formed exceptionally toxic complexes. The toxicity of many redox-active compounds and their copper complexes appears due, at least in part, to the intracellular generation of hydrogen peroxide during oxidation of these compounds, an effect exacerbated by the ability of copper to inhibit catalase. Hydrogen peroxide is highly toxic towards marine algae, and may be a natural growth-inhibiting factor. Hydroxyl radicals, generated intracellularly from a mixture of hydrogen peroxide and the lipid-soluble thiol, cysteine, were also extremely toxic. However, when hydroxy radicals or superoxide radicals were generated extracellularly, no effect on growth rate was observed, even though singlet oxygen did seriously reduce growth. (Author's abstract)
W87-06037

USE OF MARINE BENTHIC 'KEY' SPECIES ON ECOTOXICOLOGICAL TESTING: AMPHIURA FILIFORMIS (O.F. MULLER) (ECHINODERMATA: OPHIUROIDEA),
University Coll., Galway (Ireland). Dept. of Zoology.
For primary bibliographic entry see Field 5A.
W87-06038

AVOIDANCE RESPONSE OF GROUPS OF JUVENILE BROOK TROUT, SALVELINUS FONTINALIS TO VARYING LEVELS OF ACIDITY,
Concordia Univ., Loyola Campus, Montreal (Quebec). Water Pollution Research Lab.
S. C. J. Pedder, and E. J. Maly.
Aquatic Toxicology AQTODG, Vol. 8, No. 2, p 111-119, June 1986. 3 fig, 2 tab, 24 ref.

Descriptors: *Acidity, *Avoidance behavior, *Fish behavior, *Acidic water, *Trout, *Water pollution effects, Pollutants, Fish, Behavior, Hydrogen ion concentration, Population exposure.

Avoidance responses of juvenile brook trout, Salvelinus fontinalis were evaluated by exposing separate groups of 20 test individuals to a choice of untreated (pH 7.4) or decarbonated acidic waters at varying pH levels (4.0, 5.0, 5.5, 6.0). Fish behavior during the 96-h test period was recorded with a video camera placed above a two-chambered artificial stream apparatus. Results were recorded over cumulative 24-h periods (1-24, 25-48, 49-72, and 73-96 h) and over the entire test period. Significant avoidance ($P < 0.05$) of acidic waters did not occur until fish had a choice of neutral water and test water at pH 5.0, thus the avoidance threshold for brook trout would lie between pH 5.0 and 5.5. The lower pH levels (4.0, 5.0 and 5.5) were found to affect social interactions between the test individuals. No mortalities occurred during any of the control and test periods. (Author's abstract)
W87-06039

COMPARISONS OF SEVERAL STRUCTURE-TOXICITY RELATIONSHIPS FOR CHLOROPHENOLS,
Texas Tech Univ., Lubbock. Dept. of Biological Sciences.
M. P. Moulton, and T. W. Schultz.
Aquatic Toxicology AQTODG, Vol. 8, No. 2, p 121-128, June 1986. 1 fig, 5 tab, 16 ref. EPA Research agreement R-810791-01-00.

Descriptors: *Mathematical models, *Toxicity, *Chlorophenols, *Structure-activity relationships, *Data interpretation, *Statistical models, Pollutants, Structure, Molecular structure, Mathematical studies, Statistical analysis, Statistical methods, Regression analysis, Least squares method, Prediction.

Using previously obtained data, the toxic response of chlorophenols from 10 different test systems was compared. These systems used various experimental protocols including phylogenetically diverse test species. The best statistical model for explaining variation in toxic response (log TR) with changes in hydrophobicity (log K sub ow) was a traditional analysis of covariance model. This model consists of a set of parallel lines corresponding to the different test systems. The y-intercepts for these lines fell into four clearly defined subgroups. The groups revealed by least-squares means analysis included static fish systems, nonstatic fish systems, eukaryotic unicellular systems, and prokaryotic unicellular systems. In general, the toxic response of a given chlorophenol in one system could be used to predict its toxic response in other systems regardless of species or the experimental protocol. (Wood-PTT)
W87-06040

COMPARATIVE TOXICITY OF NITRITE TO FRESHWATER FISHES,
Southwest Texas State Univ., San Marcos. Aquatic Station.
J. R. Tomasso.
Aquatic Toxicology AQTODG, Vol. 8, No. 2, p 129-137, June 1986. 5 fig, 2 tab, 28 ref.

Descriptors: *Water pollution effects, *Nitrites, *Toxicity, *Chlorides, *Fish physiology, Pollutants, Fish, Sunfish, Catfish, Bass, Lethal limit, Mortality, Hemoglobin, Methemoglobin, Tolerance.

The toxicity of nitrite to several species of freshwater fishes was determined and the underlying physiological mechanisms which account for different toxicity among species were investigated. Green sunfish (Lepomis cyanellus) was the most resistant species studied while the channel catfish (Ictalurus punctatus) was the least resistant. Ninety-six hour median lethal concentrations correlated significantly with both the percentage of hemoglobin in the methemoglobin form and

plasma nitrite concentrations among species. Plasma nitrite levels also correlated significantly with percent methemoglobin. Environmental chloride did not increase the tolerance of largemouth bass (Micropterus salmoides) to nitrite toxicity as it did for channel catfish. These results indicate that plasma nitrite concentrations in various species depend on the discriminatory ability of the active transport system in fish gills which ordinarily transports chloride ions. (Author's abstract)
W87-06041

SKIN MUCOUS CELL RESPONSE TO ACID STRESS IN MALE AND FEMALE BROWN BULLHEAD CATFISH, ICTALURUS NEBULOSUS (LESUEUR),
West Virginia Univ. Medical Center, Morgantown. Dept. of Anatomy.
E. M. Zuchelkowski, R. C. Lantz, and D. E. Hinton.
Aquatic Toxicology AQTODG, Vol. 8, No. 3, p 139-148, August 1986. 3 fig, 3 tab, 28 ref. DOI Project A-037-WVU.

Descriptors: *Acid stress, *Mucosubstance, *Water pollution effects, *Acidity, *Fish physiology, *Epidermis, Catfish, Acids, Stress, Hydrogen ion concentration, Sulfuric acid, Schiff's reagent, Fish, Population exposure.

Exposure of brown bullhead catfish Ictalurus nebulosus (Lesueur) to water made acid in pH by addition of dilute sulfuric acid, removed a sexual dimorphism observed in mucosubstance-containing cells of control epidermis. When stained by the alcian blue-periodic acid Schiff's reagent technique for acidic and neutral mucosubstances, positive cells in control males are seen primarily at the external surface. A few mucosubstance-containing cells are observed in the basal regions. By contrast, skin of control female brown bullheads appears to contain far more mucosubstance. Morphometric analysis of skin reacted by the above technique for mucosubstance revealed the following: (1) mucous cells of control females are more than twice as large as those of control males; (2) 48 hours after initiation of acid stress (pH 5.7-3.8) both sexes respond with hyperplasia of mucous cells; (3) more severe acid stress (pH 5.2-3.8) leads to hypertrophy of mucous cells in epidermis of males. Preliminary observation concerning development of the response indicate that an initial increase in mucosubstance occurs throughout the entire epidermis by 48 h. This increase is followed by movement of mucous cells toward the surface and eventual release of mucosubstance. After 3 or 4 days of exposure, the majority of mucous cells appear within the upper one-third of the epidermis. Endocrine factors possibly mediating mucosubstance in control and acid-stressed epidermis are discussed. (Author's abstract)
W87-06042

RELATIONSHIP BETWEEN CHRONIC TOXICITY AND BIOACCUMULATION OF COPPER, CADMIUM AND ZINC AS AFFECTED BY WATER HARDNESS AND HUMIC ACID,
Miami Univ., Oxford, OH. Dept. of Zoology.
R. W. Winner, and J. D. Gauss.
Aquatic Toxicology AQTODG, Vol. 8, No. 3, p 149-161, August 1986. 7 fig, 30 ref. EPA Cooperative agreement 809224010.

Descriptors: *Water pollution effects, *Path of pollutants, *Toxicity, *Bioaccumulation, *Heavy metals, *Hardness, *Chemical properties, *Humic acids, *Daphnids, Pollutants, Accumulation, Copper, Cadmium, Zinc, Acids, Ions, Aquatic animals.

Using daphnids, the effects of water hardness and humic acid (HA) on the chronic toxicity and bioaccumulation of Cu, Cd and Zn were evaluated. Although changes in water hardness and HA concentration changed bioaccumulation or toxicity, or both, of each of the three metals, there was no consistent relationship between changes in toxicity and changes in bioaccumulation. Only for Cu in hard water was there a positive correlation between toxicity and bioaccumulation. The uptake of 65Zn by molted exoskeletons suggests that changes in water chemistry do indeed modify the bioavailability of metals as would be expected. That is, an increase in the concentration of Ca(2+) or Mg(2+) or the increased chelation of metals by HA should decrease bioavailability. The complex storage, transformation and excretion processes in multicellular animals, however, result in there being a poor correlation among bioavailability , bioaccumulation and toxicity. (Author's abstract)
W87-06043

ACUTE LETHAL TOXICITY OF HYDROCARBONS AND CHLORINATED HYDROCARBONS TO TWO PLANKTONIC CRUSTACEANS: THE KEY ROLE OF ORGANISM-WATER PARTITIONING,
Toronto Univ. (Ontario). Inst. for Environmental Studies.
S. Abernethy, A. M. Bobra, W. Y. Shiu, P. G. Wells, and D. Mackay.
Aquatic Toxicology AQTODG, Vol. 8, No. 3, p 163-174, August 1986. 2 fig, 1 tab, 26 ref.

Descriptors: *Water pollution effects, *Hydrocarbons, *Chlorinated hydrocarbons, *Mathematical models, *Crustaceans, *Toxicity, Pollutants, Molecular structure, Saline water, Freshwater, Lethal limit, Mortality, Solubility, Chemical properties, Organism-water partitioning, Model studies, Mathematical equations, Mathematical studies, Median tolerance limit.

The acute toxicities of 38 hydrocarbons and chlorinated hydrocarbons were determined for two planktonic crustaceans, freshwater Daphnia magna and saltwater Artemia. In both cases median lethal concentrations (LC 50 values) at 48 h and 24 h, respectively, were strongly correlated with aqueous solubility, there being little direct dependence on chemical structure. In the case of solid chemicals, it is suggested that the appropriate correlating solubility is that of the subcooled liquid chemical, not that of the solid. Many solids constrained by low water solubility are thus unable to achieve concentrations sufficient to cause acute toxicity to the test organisms. It is hypothesized that acute toxicity is non-selective and is controlled by organism-water partitioning so that each hydrocarbon group may contribute equally to toxicity and no single group of hydrocarbons is the dominant toxicant. The partitioning characteristics are expressed in two mathematical models which relate the LC 50 to the chemical properties of solubility and molar volume. (Author's abstract)
W87-06044

ACUTE ACID EXPOSURE OF RAINBOW TROUT, SALMO GAIRDNERI RICHARDSON: EFFECTS OF ALUMINUM AND CALCIUM ON ION BALANCE AND HAEMATOLOGY,
Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).
H. E. Witters.
Aquatic Toxicology AQTODG, Vol. 8, No. 3, p 197-210, August 1986. 4 fig, 1 tab, 43 ref.

Descriptors: *Water pollution effects, *Trout, *Aluminum, *Calcium, *Fish physiology, *Acidic water, Pollutants, Fish, Ions, Ion balance, Hematology, Acidic water, Acids, Toxicity, Population exposure.

Rainbow trout, acclimated to low environmental calcium (38 micro Eq/l) were acutely exposed to either acid water (pH 4.1) or acid water with aluminum (350 micrograms/l) for 3.5 h. The exposure to Al in acid water provoked a massive whole body loss of sodium, chloride and potassium which was twice as high as in fish exposed to acid water. It is demonstrated that the branchial ion loss increased, while the urinary ion loss remained the same in acid + Al conditions compared to control conditions. The presence of higher ambient Ca-levels (190 micro Eq/l) had no moderating effect on the toxicity of Al to the ion balance. Plasma ion levels and plasma osmolality declined in Al-exposed fish, indicating a possible disturbance of the osmotic equilibrium between the intracellular and extracellular compartments. This phenomenon could also give rise to a swelling of the red blood cells, thus explaining the observed higher hematocrit value in Al-exposed trout. (Author's abstract)
W87-06045

PROPOSAL FOR THE REDUCTION OF ANIMAL NUMBERS REQUIRED FOR THE ACUTE TOXICITY TO FISH TEST (LC 50 DETERMINATION),
Huntingdon Research Centre PLC (England).
For primary bibliographic entry see Field 5A.
W87-06046

BEHAVIOURAL RESPONSES OF STREAM-DWELLING ACRONEURIA LYCORIAS (INS., PLECOPT.) LARVAE TO METHOXYCHLOR AND FENITROTHION,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
E. Scherer, and R. E. McNicol.
Aquatic Toxicology AQTODG, Vol. 8, No. 4, p 251-263, September 1986. 9 fig, 1 tab, 38 ref.

Descriptors: *Water pollution effects, *Insecticides, *Methoxychlor, *Fenitrothion, *Stoneflies, *Insect behavior, Pollutants, Streams, Stream pollution, Larvae, Behavior, Distribution patterns, Sublethal effects, Hydrocarbons, Chlorinated hydrocarbons, Organophosphorus pesticides, Roseau River, Birch River, Winnipeg, Simulation, Population expsoure.

Laboratory stream channels were used to investigate responses of the stream-dwelling predatory stonefly, Acroneuria lycorias (Ins., Plecopt.), to single-pulse applications of the insecticides methoxychlor and fenitrothion. The larvae were collected in the Roseau and Birch rivers located within 100 km of Winnipeg for the laboratory experiments under controlled conditions simulating essential features of field conditions. Microhabitat preferences under unstressed conditions led, in accordance with field observations, to distribution patterns determined by thigmotaxis and phototaxis. Both methoxychlor and fenitrothion exposure at sublethal concentrations caused abandonment of microhabitats, associated with increased locomotor activity and drift. In the case of the polychlorinated hydrocarbon methoxychlor, responses were very rapid (starting within 5 minutes) and sensitive (threshold 0.5-1.0 micrograms/l). The organophosphate fenitrothion caused less pronounced immediate effects, and only at the highest concentration tested (12 micrograms/l). Delayed responses to fenitrothion occurred approximately 7-12 hours after onset of exposure to spike concentrations of 8 and 12 micrograms/l. (Wood-PTT)
W87-06047

INTERACTIVE EFFECTS OF WATER HARDNESS AND HUMIC ACID ON THE CHRONIC TOXICITY OF CADMIUM TO DAPHNIA PULEX,
Miami Univ., Oxford, OH. Dept. of Zoology.
R. W. Winner.
Aquatic Toxicology AQTODG, Vol. 8, No. 4, p 281-293, September 1986. 5 fig, 4 tab, 35 ref. EPA Cooperative agreement 809224010.

Descriptors: *Synergistic effects, *Water pollution effects, *Toxicity, *Bioaccumulation, *Crustaceans, *Cadmium, *Chemical properties, *Hardness, *Humic acids, *Daphnia, Pollutants, Heavy metals, Acids, Abortion, Mortality, Lethal limit.

The interactive effects of water hardness and humic acid on the chronic toxicity of Cadmium to the freshwater crustacean Daphnia pulex was evaluated. The chronic toxicity of Cd was reduced by an increase in water hardness from 58 to 116 mg/l; a further increase in hardness to 230 mg/l, however has no further effect on Cd toxicity. The most consistent and sensitive index of chronic Cd stress was the abortion of young. Based on this index, 0.75 or 1.50 mg/l humic acid had no effect on the chronic toxicity of Cd in either the soft or the medium-hard test waters. This was also true for 0.75 mg/l humic acid in hard water; however, the addition of 1.5 mg/l humic acid to hard water resulted in an increase in the chronic toxicity of

Cd. In conjunction with Cd exposures greater than the chronic no-effect concentration, the addition of either 0.75 or 1.50 mg humic acid per liter to water of any of the three hardnesses usually increased the mortality rate over a 42-day exposure period. The mechanism by which humic acid increases the abortion rate in hard water and increases mortality rate in soft, medium-hard and hard water is unknown. (Wood-PTT)
W87-06048

INCREASED AVAILABILITY OF CADMIUM TO PERFUSED RAINBOW TROUT (SALMO GAIRDNERI, RICH.) GILLS IN THE PRESENCE OF THE COMPLEXING AGENTS DIETHYL DITHIOCARBAMATE, ETHYL XANTHATE AND ISOPROPYL XANTHATE,
Uppsala Univ. (Sweden). Dept. of Zoophysiology.
M. Block, and P. Part.
Aquatic Toxicology AQTODG, Vol. 8, No. 4, p 295-302, September 1986. 3 fig, 23 ref. National Swedish Environmental Protection Board Grant 5311295-9.

Descriptors: *Path of pollutants, *Bioaccumulation, *Pollutants, *Water pollution effects, *Cadmium, *Chemical complexes, *Trout, Fish physiology, Heavy metals, Fish, Complexing agents, Industrial wastes, Gills, Diethyl dithiocarbamate, Ethyl xanthate, Isopropyl xanthate, Carbamates, Xanthates, Ions, Polarity, Retention.

Cadmium transfer through and retention of metal in perfused gill tissue from rainbow trout (Salmo gairdneri) was studied in the presence of three cadmium complexing agents; DDC (diethyl dithiocarbamate), ethyl xanthate and isopropyl xanthate. The complexes formed are non-polar. The transfer of complexed cadmium was greater than the transfer of free cadmium ions. The retention of cadmium in gill tissue was increased about ten times in the presence of each of the two xanthates. However, the retention in gill tissue was not altered by DDC. It is concluded that cadmium uptake in fish gills in the presence of complexing agents is not simply a function of complexed versus free metal. It is also heavily dependent on the type of complexing agent present. (Author's abstract)
W87-06049

EFFECTS OF ACIDIFICATION ON THE BEHAVIORAL RESPONSE OF CRAYFISHES (ORCONECTES VIRILIS AND PROCAMBARUS ACUTUS) TO CHEMICAL STIMULI,
Boston Univ., MA. Marine Biological Lab.
A. J. Tierney, and J. Atema.
Aquatic Toxicology AQTODG, Vol. 9, No. 1, p 1-11, October 1986. 2 fig, 2 tab, 35 ref.

Descriptors: *Water pollution effects, *Animal behavior, *Crustaceans, *Acidic water, *Chemical properties, *Crayfish, Pollutants, Behavior, Acids, Acidity, Chemical stimuli, Aquatic animals, Aquatic life, Hydrogen ion concentration, Amino acids, Population exposure.

Laboratory experiments determined how crayfish respond to differing concentrations of food-relevant chemicals under low pH conditions. At pH 5.8 the crayfishes Orconectes virilis and Procambarus acutus responded to an amino acid mixture with antennule and feeding movements. Response intensity increased with stimulus intensity. The responses were significantly reduced in both species when the animals were held for 48 h in acidified (pH 4.5 and 3.5) water; the lower the pH, the lower the responsiveness. General activity and amount of food actually consumed, however, were not affected by acidification. O. virilis was generally more sensitive to acidification than P. acutus. These results indicate that acid exposure may interfere specifically and quantitatively with chemoreceptive processes in aquatic crustaceans. (Author's abstract)
W87-06050

SUBLETHAL EFFECTS OF TETRAMETHYLTHIURAM DISULFIDE (THIRAM) IN RAINBOW TROUT (SALMO GAIRDNERI),
Rijksinstituut voor Zuivering van Afvalwater, Leylstad (Netherlands). Lab. for Ecotoxicology.
C. J. Van Leeuwen, J. L. Maas-Diepeveen, and H. C. M. Overbeek.
Aquatic Toxicology AQTODG, Vol. 9, No. 1, p 13-19, October 1986. 1 fig, 2 tab, 29 ref.

Descriptors: *Pesticides, *Water pollution effects, *Toxicity, *Trout, *Biocides, *Sublethal effects, *Thiram, Pollutants, Tetramethylthiuram disulfide, Fish, Enzymes, Glucose, Blood, Lipids, Liver, Chemical reactions.

In short-term toxicity experiments with rainbow trout (Salmo gairdneri), thiram (tetramethylthiuram disulfide) was found to lower the concentrations of protein-bound SH in the liver, and to raise the concentration of non-protein-bound SH. The lactate dehydrogenase and glucose-6-phosphate dehydrogenase activities increased. The glucose content of the blood fell, while an increase in total lipid content of the liver was found. Thiram also interfered with some hematological indices; it induced leucopenia, a fall in hemoglobin content and an increase in the osmolarity of the blood. The observed effects appear to agree well with those reported in other test systems and can be ascribed to the cytotoxic properties of thiram and/or its metabolites. (Author's abstract)
W87-06051

HISTOPATHOLOGICAL STUDY OF ORYZIAS LATIPES (MEDAKA) AFTER LONG-TERM BETA-HEXACHLOROCYCLOHEXANE EXPOSURE,
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands). Lab. for Pathology.
P. W. Wester, and J. H. Canton.
Aquatic Toxicology AQTODG, Vol. 9, No. 1, p 21-45, October 1986. 16 fig, 4 tab, 25 ref.

Descriptors: *Water pollution effects, *Toxicity, *Ricefish, *Beta-hexachlorocyclohexane, *Histopathology, Pollutants, Fish, Chemical wastes, Fish eggs, Eggs, Hermaphroditism, Population exposure.

Two toxicity experiments were carried out with the Beta-isomer of hexachlorocyclohexane (Beta-HCH) in the Japanese ricefish (medaka, Oryzias latipes). The experiments were started with freshly fertilized eggs (Experiment I) or with young fish (1 month post hatching) (Experiment II). The concentration of Beta-HCH ranged from 0.032-1.0 mg/l tank water. After 1 and 3 months histopathological examination was carried out, which revealed development of testis-ova (intersexuality, hermaphroditism) in males and induction of vitellogenesis in either sex after 3 months. These features are characteristic of estrogen-like activity. Effects on the liver and kidneys were detailed and observations which indicated a high level of activity of the thyroid were presented. In the kidneys accumulation of amorphous eosinophilic precipitate in the glomeruli (glomular hyalinosis) was prominent, and a similar precipitate could be found around the liver sinusoids and the splenic capsule; the nature of this precipitate could not be determined histochemically or electronmicroscopically. It was concluded that Beta-HCH has multiple toxic effects in medakas, some of which yield evidence for estrogen-like activity, as was also found in guppies and rodents. Exposure for 1 or 3 months in both experiments produced no-effect concentrations of 0.056 and 0.1 mg Beta-HCH/l, respectively. (Wood-PTT)
W87-06052

EFFECTS OF AROCLOR 1254 ON CYTOCHROME P-450-DEPENDENT MONOOXYGENASE, GLUTATHIONE S-TRANSFERASE, AND UDP-GLUCURONOSYLTRANSFERASE ACTIVITIES IN CHANNEL CATFISH LIVER,
Georgia Univ., Athens. Dept. of Zoology.
G. T. Ankley, V. S. Blazer, R. E. Reinert, and M. Agosin.
Aquatic Toxicology AQTODG, Vol. 9, No. 2/3, p 91-103, November 1986. 1 fig, 3 tab, 47 ref.

Descriptors: *Water pollution effects, *Arochlor 1254, *Catfish, *Enzyme activities, *Biotransformation, Pollutants, Fish, Enzymes, Metabolism.

Channel catfish (Ictalurus punctatus) were treated with single intraperitoneal injections of Aroclor 1254, ranging from 1-100 mg Aroclor 1254/kg body weight, and effects of the Aroclor in several xenobiotic-metabolizing enzymes were evaluated. Hepatic microsomal monooxygenase (MO) activity toward 7-ethoxyresorufin, 7-ethoxycoumarin and benzo(a)pyrene was increased in a dose-dependent manner. 7-Ethoxyresorufin-O-deethylase activity was increased by a dose of 1 mg Aroclor 1254/kg, whereas 7-ethoxycoumarin-O-deethylase and benzo(a)pyrene activities were increased by doses of 10 mg/kg and higher. Maximal increases in MO activity ranged from three- to 15-fold, depending in the substrate used. Treatment with 100 mg Aroclor 1254/kg increased hepatic cytosolic glutathione S-transferase (GST) activity toward 1,2-epoxy-3-(para-nitrophenoxy)propane about 20%; however, GST activity toward four other substrates was unaffected. Hepatic microsomal UDP-glucuronosyl-transferase (UDPGT) activity was increased about two-fold in catfish treated with 100 mg Aroclor 1254/kg. Treatment with doses of Aroclor 1254 lower than 100 mg/kg did not significantly increase either GST of UDPGT activities. Although MO, GST, and UDPGT activities all were increased by Aroclor 1254, the MO system was by far the most sensitive. Because these enzymes are functionally linked in the biotransformation of certain xenobiotics, different effects, such as those produced by Aroclor 1254, could alter patterns of xenobiotic metabolism and toxicity. (Author's abstract)
W87-06054

CYTOCHEMICAL LOCALIZATION OF TIN IN FRESHWATER MUSSELS EXPOSED TO DI-N-BUTYLTIN DICHLORIDE,
Utrecht Rijksuniversiteit (Netherlands). Lab. of Chemical Animal Physiology.
H. J. Herwig, and D. A. Holwerda.
Aquatic Toxicology AQTODG, Vol. 9, No. 2/3, p 117-128, November 1986. 7 fig, 44 ref.

Descriptors: *Water pollution effects, *Toxicity, *Path of pollutants, *Tin, *Chemical analysis, *Dibutyltin, *Mollusks, *Animal physiology, Pollutants, Chemical reactions, Freshwater, Aquatic animals, Dibutyltin dichloride, Sulfide-silver technique, Clams, Heavy metals, Mussels, Kidneys, Glycogen.

A sulfide-silver technique was used to study the localization of tin in several organs of freshwater mollusk, Anodonta anatina, that was exposed to a low concentration (0.125 micro-M) of di-n-butyltin dichloride for 7 months. Reaction products indicating the presence of tin were observed exclusively in a small number of membrane-limited organelles in the epithelial cells of the kidney. The presence of tin in kidney cells was accompanied by a strong decrease of the cellular glycogen content, slight morphological changes in the mitochondria and local swellings of the apical cell surface. (Author's abstract)
W87-06055

PRELIMINARY DATA ON THE DIGESTIVE CONTENTS OF THE EDIBLE SEA URCHIN PARACENTROTUS LIVIDUS (LAMARCK) SUBJECT TO THE INFLUENCE OF DOMESTIC EFFLUENTS (DONNEES PRELIMINAIRES SUR LE CONTENU DIGESTIF DE L'OURSIN COMESTIBLE PARACENTROTUS LIVIDUS (LAMARCK) SOUMIS A L'INFLUENCE D'EFFLUENTS DOMESTIQUES),
Aix-Marseille-3 Univ. (France). Lab. de Zoologie Marine.
P. Delmas, and M. B. Regis.
Marine Environmental Research MERSDW, Vol. 20, No. 3, p 197-220, 1986. 6 fig, 4 tab, 20 ref.

Descriptors: *Diets, *Food habits, *Water pollution effects, *Wastewater, *Domestic wastes, *Effluents, *Echinoderms, *Aquatic animals, Marseille, Populations, Aquatic populations, Organic carbon, Precipitation, Flocculation, Wastewater treatment, Foods, Pollutants, Outfall sewers.

Populations of the sea urchin Paracentrotus lividus were investigated in an area polluted by domestic wastes from the Marseille sewage outfall. The organic carbon near the outlets was due to particles from the precipitation and flocculation processes. The particles were quickly covered by bacteria and provided food for sea urchins which lived at a depth below 3 m. Analysis of pellets from the sea urchin stomach and gut from four stations revealed that their diet was determined by the substrate and the assemblage living within, and not upon the organic matter coming from the outlets. Pollutants from the outfall at station 0 led to a sea urchin diet that was higher in Hg, Cu, Pb, and Zn than that at station 1 where the population density was the highest. This suggested that excessive concentration of some of the pollutants prevents the sea urchins from wholly benefiting from the greater available food supply. (Author's abstract)
W87-06066

EVIDENCE FOR EXPOSURE OF FISH TO OIL SPILLED INTO THE COLUMBIA RIVER,
National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.
For primary bibliographic entry see Field 5A.
W87-06068

INFLUENCE OF VEGETATIVE SUCCESSION ON SOIL CHEMISTRY OF THE BERKSHIRES,
Williams Coll., Williamstown, MA.
D. P. Dethier, and H. W. Art.
Available from the National Technical Information Service, Springfield, VA 22161 as PB 87 112447/AS, Price codes: A09 in paper copy, A01 in microfiche. Contract No. 14-08-0001-G912-05, Project No. USGS G 912-05. Massachusetts Water Resources Center, Amherst, Publication No. 153, March 1986. 167 p, 15 fig, 16 tab, 136 ref, 4 append.

Descriptors: *Forest soils, *Forest watersheds, *Acid rain, *Acidic soils, *Chemical degradation, *Hydrogen ion concentration, *Soil absorption capacity, *Soil water, *Neutralization, Mixed forests, Chemical reactions, Hydrogeology, Weathering, Coniferous forests, Deciduous forests, Soil horizons, Soil profiles, Subsoil, Canopy, Throughfall, Berkshire Hills, Massachusetts.

This study characterizes the chemistry of precipitation, canopy leaching, and stream water as well as analyzing soil properties in a series of successional forest stands in Northwestern Berkshire County, Massachusetts. Dramatic changes occur in the pH of precipitation as it passes through forested ecosystems. Bulk precipitation has a mean pH of around 4.2 whereas streamflow has a mean pH of near 7.0. The pH, Ca, Mg, Na, K, NH4, DOC, NO3, F, Fe, Al, and CEC of soils all show consistent patterns of change with depth and are influenced by parent material and biological processes. The influence of succession on the evolution of soil pH appears to be controlled more by species composition than by age per se. Soils supporting coniferous species, oaks, or red maple usually have lower pH and basic cation concentrations than do soils supporting sugar maple, white ash, or birch species. (Kaynor-U.MA)
W87-06076

DESIGN OF A DRINKING WATER QUALITY MONITORING PROGRAM,
Massachusetts Univ., Amherst. Water Resources Research Center.
For primary bibliographic entry see Field 5G.
W87-06077

RELATIONSHIP BETWEEN CHEMICALLY DETERMINED AND BIOLOGICALLY AVAILABLE FORMS OF PHOSPHORUS IN LAKES AND STREAMS,
Rutgers - The State Univ., New Brunswick, NJ. Center for Coastal and Environmental Studies.
F. B. Trama and, and A. W. McIntosh.
Available from the National Technical Information Service, Springfield, VA 22161, as PB86 126117, Price codes: A05 in paper copy, A01 in microfiche. Center for Coastal and Environmental Studies, Div of Water Resources, Completion Report, September 1985. 80 p, 23 fig, 42 tab, 50 ref, append. Contract No. 14-34-0001-9152. Project No. B-076-NJ.

Descriptors: *Phosphorus, *Eutrophication, Reservoirs, Tributaries, Storm water, Water quality, Bioassay, Water pollution effects, Path of pollutants, Pollutant identification,, New Jersey, Round Valley Reservoir, Spruce Run Reservoir.

Concentrations of total phosphorus (TP) total dissolved, soluble reactive and bioavailable phosphorus (BAP) were determined monthly for three years in two proximal reservoirs and their major tributaries. Spruce Run reservoir was a eutrophic on-stream impoundment, and Round Valley reservoir was a mesotrophic pumped storage body of water. Baseflow and stormflow conditions were monitored for the main tributaries of Spruce Run reservoir. Temperature, light transmission, dissolved oxygen concentration and chlorophyll a levels were measured monthly in both reservoirs. Stormflows contributed about 33% of the annual TP load from Spruce Run Creek and 53% from Mulhockaway Creek to Spruce Run reservoir. Mean baseflow BAP/TP ratios were 0.43 and 0.35 for Spruce Run and Mulhockaway Creeks, respectively, but the stormflow BAP/TP ratio of 0.17 was the same for both streams. Mean TP concentrations were 15 and 29 micrograms/liter in Round Valley and Spruce Run reservoirs, respectively, but the three-year average BAP/TP ratio of 0.21 was the same for both reservoirs. Both reservoirs were efficient phosphorus traps, especially with respect to BAP concentrations, which were reduced by 72% in Spruce Run reservoir. Secchi disc depth, chlorophyll a and dissolved oxygen concentrations in Round Valley reservoir responded quickly to an episodic enrichment of phosphorus but only the chlorophyll a showed a rapid recovery. The rate of hypolimnetic oxygen consumption (AHOD) of 0.06 mg 02/cm2/day in Round Valley failed to improve during the three years of investigation. Phosphorus budgets were assembled for both reservoirs and used to compare predicted TP concentrations to those observed. An equilibrium-based model proposed by Lee et al. gave poor agreement. The Dillon-Rigler model accurately predicted the observed annual mean TP concentrations and not the springtime TP concentration it was supposed to predict. (Trama-Rutgers U.)
W87-06085

CHEMICAL PROCESSES IN LAKES.
For primary bibliographic entry see Field 2H.
W87-06126

STRATEGIES FOR MICROBIAL RESISTANCE TO HEAVY METALS,
Minnesota Univ., Navarre. Gray Freshwater Biological Inst.
J. M. Wood, and H. K. Wang.
IN: Chemical Processes in Lakes, John Wiley and Sons, New York, New York. 1985. p 81-98, 7 fig, 3 tab, 46 ref. NIH Grant AM 18101-90.

Descriptors: *Water pollution effects, *Heavy metals, *Microbiological studies, Toxicity, Cadmium, Arsenic, Oxidation, Reduction, Biosynthesis, Nickel, Copper, Calcium, Chemical precipitation, Biomethylation.

Microorganisms are adapting to environmental changes by evolving strategies to maintain low intracellular concentrations of toxic pollutants. This adaptation to resist toxic substances may have been inherited from organisms that lived in extreme environmental conditions; some bacteria have acquired resistance relatively easily through the acquisition of extrachromosomal DNA molecules. The biochemical basis for resistance to metal-ion toxicity is emerging and it is complicated by the different resistance mechanisms. Several strategies for resistance to metal-ion toxicity have been identified: (1) The development of energy-driven efflux pumps which keep toxic element levels low in the interior of the cell. Such mechanisms have been described for Cd(II) and As(V); (2) Oxidation (e.g., AsO3(2-) to AsO4(3-)) or reduction (e.g., Hg(2+) to Hg(0) can enzymatically and ultracellularly convert a more toxic form of an element to a less toxic form; (3) The biosynthesis of intracellular polymers which serve as traps for the removal of metal ions from solution, such as the traps which have been described for cadmium, calcium, nickel, and copper; (4) The binding of metal ions to cell surfaces; (5) The precipitation of insoluble metal complexes (e.g., metal sulfides and metal oxides) at cell surfaces; and (6) Biomethylation and transport through cell membranes by diffusion-controlled processes. Each of these mechanisms for resistance to toxicity requires inputs of cellular energy, and as such represents a nonequilibrium component for the distribution of elements at the earth's surfaces. (See also also W87-06126) (Author's abstract)
W87-06130

ACIDIFICATION OF AQUATIC AND TERRESTRIAL SYSTEMS,
Iowa Univ., Iowa City. Dept. of Civil and Environmental Engineering.
J. L. Schnoor, and W. Stumm.
IN: Chemical Processes in Lakes, John Wiley and Sons, New York, New York. 1985. p 311-338, 9 fig, 4 tab, 27 ref.

Descriptors: *Water pollution effects, *Acidification, *Acid rain, *Aquatic environment, Hydrogen ion concentration, Environmental effects, Chemical weathering.

The global environment is on the average, with regard to a proton and electron balance, in a stationary state. Schematically, the oxidation states and the H(+) reservoirs of the weathering sources equal those of the sedimentary products. Obviously, such balances are locally and regionally upset. In addition, they have become significantly disturbed by the combustion of fossil fuels which generates a net production of H(+) ions in atmospheric deposition. It is shown here how this disturbance is transferred to the terrestrial and aquatic environment, and the major H(+) yielding and H(+) consuming processes occurring in the watersheds are reviewed, paying special attention (1) to the disturbance of the H(+) balance resulting from temporal or spatial decoupling of the production and mineralization of the biomass, and (2) to the H(+) ion consumption by the weathering of rocks. The aggradation of vegetation (productive forests) may be accompanied by acidification of surrounding waters. In some instances, the acidic atmospheric deposition may be sufficient to disturb the existing H(+) balance between aggrading vegetation and weathering reactions. Chemical weathering is shown to be a key process in neutralizing the internal production and the anthropogenic input of acids to a watershed. The lakes which have been acidified by acid precipitation are those lacking carbonate minerals and characterized by sensitive hydrological settings. (See also W87-01626) (Author's abstract)
W87-06140

GROUNDWATER CONTAMINATION PROBLEM AND RELATED RESEARCH,
Texas Univ. at Austin. Biomedical Engineering Lab.
R. J. Charbeneau.
IN: Water Resources in Texas: The Need for a Water Research Agenda. Water Resources Symposium Number Eleven. University of Texas at Austin. Center for Research in Water Resources, 1984. p 181-190, 1 tab, 2 ref.

Descriptors: *Groundwater pollution, *Water pollution effects, *Water pollution sources, *Path of pollutants, Research priorities, Leachates, Industrial wastes, Municipal wastes.

Groundwater contamination may be defined as any activity which impairs the quality of water for plant, animal, or human use. Groundwater contamination through increases in salinity is a natural product of soil and rock weathering. The major concern here, is usually with anthropogenic sources of groundwater contamination. Well-known sources are agricultural and urban runoff,

leachates from mine spoil piles, and by-products from industrial and municipal waste disposal. In a single paper, or even a single volume, it is not possible to discuss the groundwater contamination problem in any broad and complete way. Focused on are the industrial and municipal sources of groundwater contamination. Emphasis is placed on the physical, chemical, and microbial processes that control the migration and fate of pollutants once they have reached the groundwater environment. Of equal importance are management and engineering practices that prevent groundwater contamination in the first place. However, space limitations allow only a limited discussion of these. (See also W87-06144) (Lantz-PTT)
W87-06156

PROCEEDINGS OF THE BANGKOK SYMPOSIUM ON ACID SULPHATE SOILS.
International Inst. for Land Reclamation and Improvement, Wageningen (Netherlands).
For primary bibliographic entry see Field 2G.
W87-06162

DIRECTIONS OF FURTHER RESEARCH ON ACID SULFATE SOILS,
International Rice Research Inst., Los Banos, Laguna (Philippines).
For primary bibliographic entry see Field 2G.
W87-06163

PROBLEMS OF CLASSIFYING SOILS WITH SULFIDIC HORIZONS IN PENINSULAR MALAYSIA,
Malaysian Agricultural Research and Development Inst., Serdang.
For primary bibliographic entry see Field 2G.
W87-06168

CHEMICAL CHARACTERISTICS AND FERTILITY STATUS OF ACID SULPHATE SOILS OF THAILAND,
Kasetsart Univ., Bangkok (Thailand). Dept. of Soils.
T. Attanandana, S. Vacharotayan, and K. Kyuma.
IN: Proceedings of the Bangkok Symposium on Acid Sulphate Soils, Second International Symposium on Acid Sulphate Soils, Bangkok, Thailand, January 18-24, 1981. ILRI Publication 31, 1982. p 137-156, 9 tab, 9 ref.

Descriptors: *Soil reclamation, *Soil-water-plant relationships, *Water pollution effects, *Soil fertility, *Acidic soils, *Thailand, Chemical analysis, Nitrogen, Phosphorus, Potassium, Rice, Hydrogen ion concentration, Sulfates, Sulfur, Iron, Manganese, Calcium, Silicon.

Topsoils of two Typic Tropaquepts (Ratchaburi and Bangkok series) and three Sulfic Tropaquepts (Sena and Rangsit series and Rangsit very acid phase) were analyzed and planted with rice in pots to study their intrinsic fertility status through responses to N, P and K fertilizer and nutrient uptake of plants. Moreover, for Rangsit very acid soil the effect of liming on fertility status was tested. The sampled soils are common rice soils of the Central Plain of Thailand. The Typic Tropaquepts are rated very well suited for paddy production, and the Sena, Rangsit and Rangsit very acid soils are rated respectively as well, moderately and poorly suited. Intrinsic chemical characteristics and fertility status of the topsoils as determined in laboratory and greenhouse are discussed in relation to these suitability ratings that pertain to plant performance in field conditions. The chemical characteristics reflect mainly sedimentary origin and acidity of the topsoils. Rangsit very acid soil stands out by lowest pH (3.9), highest total S and extractable Al, and lowest values for total CaO and MnO2, extractable Fe and Mn and available P, Ca and Si, contrasting with the opposite ranking for the least acid (pH 5.8) Rachaburi soil. From the combined results it is concluded that of the three acid sulfate soils studied, only Rangsit very acid soil has intrinsic topsoil properties that cause poor plant performance. The topsoils of Rangsit and Sena soils, although strongly acid, have a potential productivity at least equal to that of the moderately and weakly acid Bangkok and Bachaburi soils. The differences in suitability ratings for these latter four soil series, based on plant performance in the field, must be due to external causes such as water management or subsoil influences. (See also W87-06162) (Lantz-PTT)
W87-06170

RICE CULTIVATION ON ACID SULPHATE SOILS IN THE VIETNAMESE MEKONG DELTA,
Can Tho Coll. (Vietnam).
For primary bibliographic entry see Field 5G.
W87-06178

VARIETAL REACTIONS OF RICE TO IRON TOXICITY ON AN ACID SULFATE SOIL,
International Rice Research Inst., Los Banos, Laguna (Philippines).
F. N. Ponnamperuma, and J. L. Solivas.
IN: Proceedings of the Bangkok Symposium on Acid Sulphate Soils, Second International Symposium on Acid Sulphate Soils, Bangkok, Thailand, January 18-24, 1981. ILRI Publication 31, 1982. p 291-301, 7 tab, 21 ref.

Descriptors: *Water pollution effects, *Rice, *Acidic soils, *Iron, *Philippines, Acid sulfates, Agriculture.

A total of 420 rices was screened on an acid sulfate soil in a farmer's field, Albay, Philippines, during three seasons. Forty-one were found to have tolerance for iron toxicity. Iron toxicity was severe in the wet season following the dry season apparently because of strong acidification following soil drying. But the tolerant rices generally fared better than the susceptible in both seasons. Yield trials confirmed the tolerance of the varieties identified as tolerant in mass screening tests. Tolerant rices gave grain yields of nearly 3 t/ha when iron toxicity was severe and over 6 t/ha when it was mild. Tolerant varieties may be a substitute for lime on moderately toxic acid sulfate soils. (See also W87-06162) (Lantz-PTT)
W87-06181

RAPID RECLAMATION OF BRACKISH WATER FISHPONDS IN ACID SULFATE SOILS,
International Rice Research Inst., Los Banos, Laguna (Philippines).
For primary bibliographic entry see Field 5G.
W87-06183

MANAGEMENT OF ACID SULFATE SOILS FOR BRACKISH WATER FISHPONDS: EXPERIENCE IN THE PHILIPPINES,
Brackish Water Aquaculture Center, Leganes, Iloilo (Philippines).
For primary bibliographic entry see Field 5G.
W87-06184

POLLUTANTS AND THEIR ECOTOXICOLOGICAL SIGNIFICANCE.
John Wiley and Sons, Chichester, England, 1985. 515 p. Edited by H. W. Nurnberg.

Descriptors: *Water pollution effects, *Path of pollutants, *Water pollution sources, *Ecological effects, *Environmental effects, Polyaromatic hydrocarbons, Halogens, Pesticides, Heavy metals, Ecosystems.

Certain organic substances, e.g. halocarbons, polyaromatic hydrocarbons, chlorinated pesticides, as well as inorganic chemicals, e.g. SO2, NOx, and hazardous heavy metals (cadmium, lead, mercury, chromium, nickel, arsenic and at higher doses a number of other metals) have already been shown to exert significant ecotoxicity partially, even at rather low levels. The ecological chemistry of these ecotoxic substances is complex and their fate, transfer and pathways in the atmosphere, the various aquatic and terrestrial ecosystems and their numerous divergent components (water, suspended matter, sediments, plankton, aquatic organisms, plants, soil, animals) depend on a number of chemical, physical, hydrological, geological, biological and ecological parameters, specific for the type of ecosystem involved. This is well reflected by the treatment of these topics and the aforementioned categories of organic and inorganic chemical pollutants in the chapters of this book. Many hazardous substances exist in the ecosystems at trace levels as a consequence of their distribution after emission. Therefore, their ecochemistry is often demanding applied trace chemistry. This means that a number of special methodological problems and requirements must be scrupulously met if accurate and reliable results are to be obtained, which is a mandatory prerequisite for relevant judgments and conclusions on the ecotoxicity of the studied pollutant. In view of the significance and interdisciplinary character of the subject it was the concept of this book to assemble a number of experts to deal with the various important aspects of the related ecochemistry and ecotoxicology of the known focal organic and inorganic pollutants in the atmosphere, hydrosphere, terrestrial environment and in man. This is supplemented by contributions on regulatory aspects. (See also W87-06188 thru W87-06197) (Lantz-PTT)
W87-06187

BASIC ECOLOGICAL PARAMETERS, MONITORING AND BIOLOGICAL MONITORS IN THE AQUATIC ENVIRONMENT,
Barcelona Univ. (Spain). Facultat de Biologia.
For primary bibliographic entry see Field 5B.
W87-06188

REGIONAL CASE STUDY OF THE POLLUTION OF NATURAL WATERS, SOILS AND PLANTS BY LEAD, CADMIUM AND ZINC,
Paris-7 Univ. (France). Lab. de Chimie Minerale des Milieux Naturels.
For primary bibliographic entry see Field 5B.
W87-06190

CHEMICAL POLLUTANTS IN THE MARINE ENVIRONMENT, WITH PARTICULAR REFERENCE TO THE NORTH SEA,
Kiel Univ. (Germany, F.R.). Inst. fuer Meereskunde.
J. C. Dunker.
IN: Pollutants and Their Ecotoxicological Significance, John Wiley and Sons, Chichester, England, 1985. p 255-268, 6 fig, 1 tab, 28 ref.

Descriptors: *Water pollution effects, *Marine environment, *North Sea, *Path of pollutants, Heavy metals, Organochlorines, Estuaries, Dissolved solids.

Present knowledge of the effects of metals and organochlorines derived from the Rhine/Meuse system in the adjacent coastal area is discussed. Dissolved and suspended components are distinguished as they have different transport mechanisms within the estuarine and coastal environment. Several metals are removed from solution during estuarine mixing. However, several dissolved organochlorines behave in a conservative way during mixing in the estuarine zone. It appears that this behavior is maintained during transport in the coastal region. High organochlorine concentrations are detected in marine mammals from the Dutch coast. This may be related to the strong decrease in the population of several species during the last decades. (See also W87-06187) (Lantz-PTT)
W87-06194

ASSESSING POLLUTION IN THE MEDITERRANEAN SEA,
International Lab. of Marine Radioactivity, Monaco-Ville (Monaco).
S. W. Fowler.
IN: Pollutants and Their Ecotoxicological Significance, John Wiley and Sons, Chichester, England, 1985. p 269-287, 1 fig, 8 tab, 45 ref.

Descriptors: *Mediterranean Sea, *Water pollution effects, *Path of pollutants, Fate of pollutants,

Hydrocarbons, Sediment contamination, Heavy metals, Radionuclides, Wastewater, Oil pollution.

Much attention is being focused on assessing pollution in the Mediterranean Sea, a semi-enclosed body of water whose unique oceanographic and geographic characteristics could lead to a magnification of pollution effects. Recent studies aimed at defining the current levels and effects of heavy metals, chlorinated hydrocarbons, petroleum hydrocarbons, artificial radionuclides and sewage in environmental samples are highlighted. In general, heavy metals and chlorinated hydrocarbons in coastal waters, sediments and organisms are variable with high levels found near population centers, river outflows and industrial outfalls. Although the data base is skewed toward the northwest Mediterranean, the information available suggests that this region is, in fact, under the greatest stress of pollution. Mercury concentrations in certain pelagic fish are higher than in corresponding specimens from the Atlantic. These differences have been thought to result from the large-scale anomalies present in the Mediterranean; however, this hypothesis is not in accord with the finding that mercury levels in open waters, sediments and smaller aquatic biota are similar to those in areas outside the Mediterranean. At present, radionuclide levels arise entirely from atmospheric fallout, and future inputs from land-based sources are not expected to alter these concentrations significantly. The degree of soil and sewage pollution appears to be greater in the Mediterranean than elsewhere, with sewage posing health problems while oil so far is affecting only tourism. (See also W87-06187) (Lantz-PTT)
W87-06195

GROUNDWATER POLLUTION MICROBIOLOGY.
John Wiley and Sons, New York, New York, 1984. 377 p. Edited by Gabriel Bitton and Charles P. Gerba.

Descriptors: *Groundwater pollution, *Path of pollutants, *Microbiological studies, *Water pollution effects, Fate of pollutants, Environmental effects, Microorganisms.

Groundwater has historically been considered a reliable and safe source of water, protected from surface contamination by a 'living filter', an upper soil mantle that removes pollutants as the water percolates downward through the soil. However, a number of well documented outbreaks of hepatitis A and viral gastroenteritis traced to contaminated groundwater, as well as numerous reports of chemical contamination, have destroyed the widely held misconception that groundwater is safe from pollution. This has necessitated a reassessment of what is known about the fates of pathogenic microorganisms and chemical pollutants in soil and groundwater. Less is known about the microbiology of groundwater than about any other part of the biosphere. The significance of microbiology as it relates to groundwater resides in the interactions of pollutants and microorganisms in the subsurface and the effects of such interactions on the quality of groundwater. Determinations of the nature and extent of microbial activity in the subsurface, the movement and fate of pathogens, and the controlling environmental factors are essential if groundwater quality is to be protected. The purpose of this book is to present a concise review of the available information on groundwater pollution microbiology. (See also W87-06202 thru W87-06215) (Lantz-PTT)
W87-06201

HEALTH ASPECTS OF GROUNDWATER POLLUTION,
Health Effects Research Lab., Cincinnati, OH.
G. F. Craun.
IN: Groundwater Pollution Microbiology, John Wiley and Sons, New York, New York, 1984. p 135-179, 1 fig, 20 tab, 109 ref.

Descriptors: *Groundwater pollution, *Health aspects, *Water pollution effects, *Fate of pollutants, Water pollution sources, *Path of pollutants, Viruses, Bacteria, Nitrates, Fluorides, Sodium, Arsenic, Selenium.

Waterborne illness can be contracted in a number of ways: (1) ingestion of contaminated water or ice; (2) contact through bathing, swimming or wading; (3) inhalation of aerosols, gases, or vapors from contaminated water or wastewater; (4) insufficient supply of water, which makes water generally unavailable for bathing and washing and contributes to the person-to-person transmission of infectious diseases. The emphasis of this paper is on illness and the human health effects associated with ingestion of contaminants in drinking water. Biological contaminants (viruses, bacteria, and parasites), inorganic contaminants (nitrate, fluoride, water hardness, sodium, arsenic, selenium) and organic chemicals are all discussed with respect to toxicity, transmission, distribution and final disposition and effects. (See also W87-06201) (Lantz-PTT)
W87-06208

INTRODUCTION TO WATER QUALITY MODELLING.
For primary bibliographic entry see Field 5B.
W87-06216

ACID SULPHATE SOILS: A BASELINE FOR RESEARCH AND DEVELOPMENT,
International Inst. for Land Reclamation and Improvement, Wageningen (Netherlands).
For primary bibliographic entry see Field 5B.
W87-06233

ACID RAIN: A WATER RESOURCES ISSUE FOR THE 80'S.
American Water Resources Association, Bethesda, MD.
For primary bibliographic entry see Field 5B.
W87-06258

U.S. NATIONAL ACID PRECIPITATION ASSESSMENT PROGRAM,
National Acid Precipitation Assessment Program, Washington, DC.
C. Bernabo, and R. Herrmann.
IN: Acid Rain: A Water Resources Issue for the 80's, American Water Resources Association, 5410 Grosvenor Lane, Bethesda, Maryland, 1983. p 13-15.

Descriptors: *Acid rain, *Environmental effects, *Federal programs, Legislation, Standards, Water pollution sources, Monitoring, Fate of pollutants, Ecological effecs, Water pollution effects, Regulations.

The National Acid Precipitation Assessment Program (NAPAP) was mandated by Congress (P.L. 96-294) to provide a better understanding of the causes, effects, and options for managing 'acid rain.' The U.S. Interagency Task Force on Acid Precipitation is charged with planning and implementing the National Program. The Task Force integrates and coordinates the diverse federal efforts to establish a firmer scientific basis for formulating energy and environmental policy. Twelve federal agencies participate in the Task Force, which is jointly chaired by USDA, EPA, and NOAA. A 10-year National Plan was issued in June 1982, and it provides a general description of the priorities, objectives, focus, and resources of the program. Nine technical 'task groups' are responsible for developing detailed operational plans for research categories including: natural sources, man-made sources, atmospheric processes, deposition monitoring, aquatic impacts, terrestrial impacts, materials effects, control technology, and assessments and policy analysis. The Task Force also coordinates the federal program with the research and monitoring activities of states, universities, private sector groups, and other nations. In conducting the National Program, the Task Force is utilizing various cooperative assessment activities and interdisciplinary analyses of complex regional, national, and international data sets such as those generated by the National Atmospheric Deposition Program, ILWAS, SNSF, and CANSAP. (See also W87-06258) (Author's abstract)
W87-06260

GAS PHASE AND PRECIPITATION ACIDITIES IN THE COLORADO MOUNTAINS,
Colorado Coll., Colorado Springs. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W87-06261

SPATIAL AND TEMPORAL TRENDS IN THE CHEMISTRY OF ATMOSPHERIC DEPOSITION IN NEW ENGLAND,
Maine Univ. at Orono. Dept. of Geological Sciences.
For primary bibliographic entry see Field 5B.
W87-06262

ACID PRECIPITATION AND BUFFER CAPACITY OF LAKES IN THE SIERRA NEVADA, CALIFORNIA,
California Univ., Santa Barbara. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5B.
W87-06263

ACID PRECIPITATION: THE IMPACT ON TWO HEADWATER STREAMS IN SHENANDOAH NATIONAL PARK, VIRGINIA,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
P. W. Shaffer, and J. N. Galloway.
IN: Acid Rain: A Water Resources Issue for the 80's, American Water Resources Association, 5410 Grosvenor Lane, Bethesda, Maryland, 1983. p 43-53, 5 fig, 3 tab, 23 ref.

Descriptors: *Acid rain, *Water pollution effects, *Virginia, *Shenandoah National Park, *Fate of pollutants, Environmental effects, Watersheds, Temporal variation, Chemical analysis, Seasonal variation, Bicarbonates, Magnesium, Sulfates, Nitrates, Ammonia, Potassium.

The Shenandoah Watershed Acidification Study (SWAS) was initiated in October 1979 to evaluate the present and future impact of acid precipitation on soil and stream water chemistry in the Shenandoah National Park. The study focuses on two small watersheds in the park. Weekly precipitation and stream water chemistry sampling has been carried out since November 1979; results for the first two years are presented. Temporal data shows dilute but stable water chemistry except for a modest summer increase in bicarbonate and associated base cations in one of the study streams. Sulfate is the dominant anion, magnesium and potassium the dominant cations. Input-output budgets show that many major cations and anions are accumulating in the watersheds, including H(+), NH4(+), NO3(-), SO4(2-), and Ca(2+), while there is net export of K(+), Mg(2+), HCO3(-), and silica. Sodium and chloride show net export during periods of high stream discharge, and accumulation during low flow; long term input and output are probably about equal. Stability of stream water chemistry appears to be controlled primarily by sulfate adsorption, bicarbonate production, and cation exchange equilibria in the soil. Because sulfate adsorption capacity is finite and because there is net export of base cations from soil, current stability is achieved at the cost of long term degradation of the soil system. (See also W87-06258) (Author's abstract)
W87-06264

IMPACT OF ATMOSPHERIC DEPOSITION ON THE WATER QUALITY OF EVERGLADES NATIONAL PARK,
Everglades National Park, Homestead, FL. South Florida Research Center.
M. D. Flora, and P. C. Rosendahl.
IN: Acid Rain: A Water Resources Issue for the 80's, American Water Resources Association, 5410 Grosvenor Lane, Bethesda, Maryland, 1983. p 55-61, 1 fig, 5 tab, 19 ref.

Descriptors: *Acid rain, *Water quality, *Water pollution effects, *Everglades National Park, *Florida, *Path of pollutants, Air pollution, Am-

monium, Nitrates, Calcium, Sodium, Magnesium, Chlorides, Sulfates, Marshes.

A preliminary investigation of the relationship between surface loading and atmospheric deposition indicates that precipitation is responsible for a significant percentage of the chemical constituents entering the unique fresh water marsh system of Everglades National Park. From June 1980 through August 1981, wetfall contributed more than 95% of the ammonium and nitrate and 83% of the orthophosphate entering the 10000 sq km Shark River Slough, the major fresh water drainage of Everglades National Park. Conversely, surface water delivery is responsible for more than 95% of the calcium, sodium, magnesium, and chloride; and more than 85% of the sulfate input to the slough. The mean volume weighted pH of precipitation during this 14-month period was 4.9, which while acidic, is not sufficient to alter the pH of the highly buffered surface water of the slough, which has a mean alkalinity of 182 mg/L (as CaCO3). (See also W87-06258) (Author's abstract)
W87-06265

RED SPRUCE DIEBACK IN VERMONT AND NEW HAMPSHIRE: IS ACID PRECIPITATION A CONTRIBUTING STRESS,
Pennsylvania Univ., Philadelphia. Dept. of Geology.
A. H. Johnson, D. G. Lord, and T. G. Siccama.
IN: Acid Rain: A Water Resources Issue for the 80's, American Water Resources Association, 5410 Grosvenor Lane, Bethesda, Maryland, 1983. p 63-67, 4 fig, 4 tab, 18 ref.

Descriptors: *Water pollution effects, *Vermont, *New Hampshire, *Red spruce trees, *Acid rain, Forests, Environmental effects, Hydrogen ion concentration, Soil chemistry, Chemical analysis, Foliage, Aluminum.

A dieback of red spruce (Picea rubens) has been quantitatively documented in the high elevation boreal forest of Vermont, and observed in New Hampshire and New York. No primary pathogens or obvious abiotic factors appear to be responsible for the dieback. The boreal forest of the Green and White Mountain peaks is above cloud base for extended periods (800-1600 hr/yr), and cloud moisture is very acidic/(average pH approximately 3.7). A study of foliar, root, and soil chemistry in healthy and declining stands in Vermont and New Hampshire leaves open the possibility of acid rain induced stress due to effects on foliage or, less likely, effects due to high levels of root aluminum. (See also W87-06258) (Author's abstract)
W87-06266

EFFECTS OF AMBIENT CONCENTRATIONS OF AIR POLLUTANTS ON VEGETATION INDIGENOUS TO THE BLUE RIDGE MOUNTAINS OF VIRGINIA,
Pennsylvania State Univ., University Park. Dept. of Plant Pathology.
J. M. Skelly, B. I. Chevone, and Y. S. Yang.
IN: Acid Rain: A Water Resources Issue for the 80's, American Water Resources Association, 5410 Grosvenor Lane, Bethesda, Maryland, 1983. p 69-73, 5 tab, 24 ref. National Park Service Contract No. CX001-9-0011.

Descriptors: *Water pollution effects, *Air pollution, *Vegetation, *Blue Ridge Mountains, *Virginia, *Shenandoah National Park, Ozone, Sulfur dioxide, Photochemicals, Environmental effects, Seasonal variation, Acid rain.

Vegetation indigenous to the Shenandoah National Park (SNP) and Blue Ridge Mountains of Virginia has been exposed to phytotoxic concentrations of oxidant air pollution, primarily ozone (O3), over the past several years. Exposure of vegetation to episodic O3 incursions has resulted in visible symptom expression on several native plant species. Longer term, low dosage exposures typically recorded throughout the summer oxidant season have been demonstrated to reduce foliar biomass production of native forbes, grasses, and sedges via an air pollutant exclusion chamber system in the Big Meadows area of the SNP. Seedling height growth of several forest tree species was also adversely affected by ambient oxidant concentrations. Monitoring data for O3 and SO2 at SNP from 1979-1981 have demonstrated that O3 was present in eight-hour (1100-1800 EST) average concentrations of 0.023 to 0.059 ppm O3 during April through September; hourly average SO2 concentrations rarely exceeded 0.006 ppm. Analysis of weekly rainfall samples has also been conducted since November of 1978 with the lowest pH rainfall recorded of 3.39. The average pH of all weekly samples is about 4.35. No effects on vegetation in the Blue Ridge Mountains have been ascribed to acidified rainfall. (See also W87-06258) (Author's abstract)
W87-06267

POTENTIAL FOR ACID PRECIPITATION DAMAGE TO LAKES OF THE SIERRA NEVADA, CALIFORNIA,
California Univ., Berkeley. Lawrence Berkeley Lab.
K. A. Tonnessen, and J. Harte.
IN: Acid Rain: A Water Resources Issue for the 80's, American Water Resources Association, 5410 Grosvenor Lane, Bethesda, Maryland, 1983. p 75-78, 3 fig, 1 tab, 10 ref.

Descriptors: *Water pollution effects, *Acid rain, *California, *Sierra Nevada Mountains, Mountains, Hydrogen ion concentration, Environmental effects, Ecological effects, Lakes.

Acid precipitation has been measured in many areas of California, including the Sierra Nevada. This region is characterized by high elevation, granite based lakes which may be sensitive to acid inputs. Possible damage to these aquatic systems due to continued acid deposition was investigated during a program of field monitoring and laboratory microcosm experiments. During 1979-1981 Sierra lake water samples were analyzed for pH, alkalinity, and concentrations of major and minor cations. Microcosm systems, established in a controlled laboratory environment using lake water and sediments, were treated with nitric acid and then analyzed for changes in chemical and biological variables. The results indicate the importance of littoral sediment leaching of Al, Mn, and Fe. A progressive loss of alkalinity together with increases in the levels of these elements in the water column of Sierra lakes might be an early sign of watershed acidification. Planktonic chlorophyte populations were relatively unaffected by the acid treatment; chrysophytes (particularly diatoms) were adversely affected by the acidified systems. In all the treatments a mat of filameentous green algae formed on the bottom of the tanks, a result similar to that observed in other experiments and field observations (See also W87-06258) (Peters-PTT)
W87-06268

VARIATION IN ECOSYSTEM SENSITIVITY AND RESPONSE TO ANTHROPOGENIC ATMOSPHERIC INPUTS, UPPER GREAT LAKES REGION,
Michigan Technological Univ., Houghton. Dept. of Biological Sciences.
J. R. Stottlemyer.
IN: Acid Rain: A Water Resources Issue for the 80's, American Water Resources Association, 5410 Grosvenor Lane, Bethesda, Maryland, 1983. p 79-83, 1 fig, 5 tab, 10 ref.

Descriptors: *Acid rain, *Water pollution effects, *Ecological effects, *Great Lakes, *Michigan, *Minnesota, Air pollution, Hydrogen ion concentration, Lake Superior, Ecosystems, Environmental effects, Snowfall, Watersheds.

Precipitation throughout the Upper Great Lakes Region is considered to be acidic. Average annual values range from pH 4.4 in lower Michigan to 5.2 in western Minnesota. In the central portion of the region the comparative values for average annual pH has fallen from 6 to 4.6 since 1955. Baseline data are few, but it appears the regional loading of acidity and associated contaminants is increasing. The Lake Superior basin typifies regional ecological diversity with northern hardwood forest and sedimentary bedrock on the south shore and boreal coniferous forests on Precambrian substrates on the north shore. Isle Royale and basin ecosystem studies show that Lake Superior significantly modifies precipitation inputs temporally and spatially. Often, more than 50% of the annual input is snow. Snowfall can increase 3X with a rise of 100-m above the lake. This results in the heaviest load of atmospheric contaminants in the more sensitive low order waatersheds. Hardwood forest canopies seasonally neutralize acid precipitation. Boreal conifer canopies have minimal effect. Glacial till quality appears more important than bedrock composition in determining whether acid precipitation is neutralized by carbonates or basic aluminum salts. The latter case can result in the release of soluble Al. The vulnerability of lakes and streams is known to be dependent on the nature and degree of watershed buffering. Watersheds with northern hardwoods generally have extensive glacial till, and this vegetation/soil interaction suggests that such ecosystems are much more resistant to the direct impacts of acid precipitation than are boreal ecosystems. (See also W87-06258) (Author's abstract)
W87-06269

IMPACTS OF CONTINUED GROWTH ON THE ENVIRONMENTALLY SENSITIVE INLAND BAYS AREA OF DELAWARE AND POLICY RECOMMENDATIONS FOR ENVIRONMENTAL CONTROL,
Greeley-Polhemus Group, Inc., West Chester, PA.
For primary bibliographic entry see Field 4C.
W87-06275

HEAVY METALS IN NATURAL WATERS: APPLIED MONITORING AND IMPACT ASSESSMENT,
Alberta Environmental Centre, Vegreville.
For primary bibliographic entry see Field 5B.
W87-06295

STRUCTURE-ACTIVITY RELATIONSHIP STUDIES ON THE TOXICITIES OF BENZENE DERIVATIVES: II. AN ANALYSIS OF BENZENE SUBSTITUENT EFFECTS ON TOXICITY,
Eastern Nazarene Coll., Quincy, MA. Dept. of Chemistry.
L. H. Hall, and L. B. Kier.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 4, p 333-337, April 1986. 6 tab, 4 ref.

Descriptors: *Model studies, *Toxicity, *Benzenes, *Minnows, *Water pollution effects, *Nitrobenzenes, *QSAR, Regression analysis, Aromatic compounds, Organic compounds.

The toxicity of benzene derivatives to fathead minnows is analyzed in terms of an additivity model. Each substituent appears to contribute a constant and additive amount to the overall toxicity of the benzene derivatives in the data set. However, the nitro group does display some unusual behavior within the additivity model. The model put forth in a previous article is reexamined with respect to the nitro group contribution. A new set of values for nitro groups is developed, giving a contribution for the mono nitro, meta dinitro and ortho/para dinitro groups. There is a modest improvement in the correlation statistics: $r = 0.953$, $s = 0.243$ and $F = 81.7$ for seven regression variables. Some suggestions concerning mechanism are made based on the toxicity coefficients. (Author's abstract)
W87-06309

ACUTE AQUATIC TOXICITY TESTS WITH ACRYLAMIDE MONOMER AND MACROINVERTEBRATES AND FISH,
Standard Oil Co. (Ohio), Cleveland.
G. R. Krautter, R. W. Mast, H. C. Alexander, C. H. Wolf, and M. A. Friedman.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 4, p 373-377, April 1986. 2 tab, 21 ref.

Descriptors: *Water pollution effects, *Macroinvertebrates, *Acrylamide, *Toxicity, *Population exposure, *Daphnids, Midges, Trout, Minnows, Bluegills, Fish, Survival, Mortality, Organic compounds, Monomers.

Aquatic toxicity tests were conducted to determine the acute toxicity of acrylamide monomer to two species of aquatic macroinvertebrates (48-h LC50) and three species of fish (96-h LC50). The test animals were daphnids (Daphnia magna), midges (Paratanytarsus parthenogenetica), rainbow trout (Salmo gairdneri), fathead minnows (Pimephales promelas) and bluegill (Lepomis macrochirus). The organisms were exposed to five concentrations of acrylamide and a control, using intermittent-flow procedures. The proportional diluter system was calibrated and the test system equilibrated before the tests were begun. Acrylamide monomer concentrations were analytically determined at equilibration, initiation and termination of the tests. Macroinvertebrates and fishes were observed for mortality and abnormal behavior twice daily for the duration of the tests. The calculated LC50s, based on measured concentrations of acrylamide monomer, were as follows: daphnids, 160 mg/L; midges, 410 mg/L; rainbow trout, 110 mg/L; fathead minnows, 120 mg/L; bluegill, 100 mg/L. These values were three orders of magnitude higher than those concentrations previously reported to increase invertebrate mortality under field conditions. The results demonstrated that acrylamide monomer was moderately toxic to the five aquatic organisms studied, under the test conditions utilized. (Author's abstract)
W87-06313

RELATIVE SENSITIVITY OF THREE DAPHNID SPECIES TO SELECTED ORGANIC AND INORGANIC CHEMICALS,
Minnesota Mining and Mfg. Co., St. Paul. Environmental Lab.
M. T. Elnabarawy, A. N. Welter, and R. R. Robideau.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 4, p 393-398, April 1986. 7 tab, 22 ref.

Descriptors: *Water pollution effects, *Daphnids, *Cladocera, *Organic compounds, *Inorganic compounds, *Toxicity, *Sensitivity, *Bioindicators, Heavy metals, Reproduction, Survival.

Static acute and renewal chronic tests were conducted with Daphnia magna, Daphnia pulex and Ceriodaphnia reticulata to determine their relative sensitivities to selected organic and inorganic chemicals: 2-chloroethanol, 2,4-pentanedione, pentachlorophenol, hexachloroethane, 2,2,2-trichloroethanol, 2-methyl-1-propanol, 2-methyl-2,4-pentadiol, Endrin(R), silver, lead, chromium, cadmium, copper, arsenic and mercury. The three species tested yielded comparable acute EC50 values for most chemicals tested. The acute EC50 values for D. magna, D. pulex and C. reticulata varied two-fold for hexachloroethane, Endrin, cadmium, arsenic and mercury. Chronic EC50 values for the three species were within one order of magnitude for 2-chloroethanol, 2,4-pentanedione, cadmium, chromium and silver. Differences in the sensitivities of these three popular cladoceran test species were within one order of magnitude. Reproductive impairment in all three test species appeared to be a more sensitive indicator of chronic toxicity than survival. This study suggest that the 7-d Ceriodaphnia chronic test may be used as an alternative short-term method for the screening of chemical toxicities. (Author's abstract)
W87-06314

SITE-SPECIFIC WATER QUALITY CRITERIA FROM IN-STREAM MONITORING DATA,
American Electric Power Service Corp., Columbus, OH. Environmental Engineering Div.
For primary bibliographic entry see Field 5A.
W87-06315

SITE-SPECIFIC TOXICITY OF UN-IONIZED AMMONIA IN THE TITTABAWASSEE RIVER AT MIDLAND, MICHIGAN: OVERVIEW,
Dow Chemical U.S.A., Midland, MI. Mammalian and Environmental Toxicology.
H. C. Alexander, P. B. Latvaitis, and D. L. Hopkins.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 5, p 427-435, May 1986. 1 fig, 7 tab, 21 ref.

Descriptors: *Tittabawassee River, *Toxicity, *Ammonia, *Water pollution effects, *Water quality standards, *Effluents, Rivers, Michigan, Walleye, Minnows, Larvae, Embryos.

Site-specific acute and chronic toxicity tests with un-ionized ammonia were conducted in Tittabawassee River water from Midland, Michigan. The results of these tests were used by the State of Michigan Department of Natural Resources (MDNR) to establish site-specific acute and chronic un-ionized ammonia water quality criteria for the portion of the river at Midland. The acute water-quality criterion established by the state using walleye data from this study was 1.0 mg/L un-ionized ammonia nitrogen. The chronic criterion established using fathead minnow embryo-larval data was 0.095 mg/L un-ionized ammonia nitrogen. The chronic criterion was used in determining the assimilative capacity for ammonia in this portion of the river. The MDNR allocated a portion of the assimilative capacity to each discharger and set effluent limitations based on the allocated capacities. Ammonia effluent limits have been set in the National Pollutant Discharge Elimination System (NPDES) permits of the Dow Chemical Company and the City of Midland. Ammonia effluent limits will be set in the NPDES permit of the Consumers Power Company. (See also W87-06317 thru W87-06318) (Author's abstract)
W87-06316

ACUTE AND CHRONIC TOXICITY OF AMMONIA TO FRESHWATER FISH: A SITE-SPECIFIC STUDY,
Dow Chemical U.S.A., Midland, MI. Health and Environmental Sciences.
M. A. Mayes, H. C. Alexander, D. L. Hopkins, and P. B. Latvaitis.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 5, p 437-442, May 1986. 3 tab, 26 ref.

Descriptors: *Tittabawassee River, *Ammonia, *Toxicity, *Water Pollution effects, *Water quality standards, Bluegills, Walleye, Minnows, Rivers, Michigan, Growth, Hatching, Larvae, Embryos.

The toxicity of ammonia to the juvenile stages of the bluegill (Lepomis macrochirus) and the walleye (Stizostedion vitreum), and to the embryo, larval and juvenile stages of the fathead minnow (Pimephales promelas) was determined in support of the development of a site-specific water quality standard for ammonia in the Tittabawassee River at Midland, Michigan. There was little difference among the acute toxicities of ammonia (expressed as un-ionized ammonia nitrogen NH3-N) to the three species tested, with 96-h LC50 values of 1.04, 1.06 and 1.50 mg NH3-N/L for the bluegill, walleye and fathead minnow, respectively. Evaluation of the chronic data showed no concentration-related effects for hatching success and growth. However, there was a significant (alpha = 0.05) decrease in number of normal larvae at hatch and in larval survival at 0.26 mg NH3-N/L, or 0.21 mg NH3-N/L when expressed as the geometric mean of these values. Both the acute and chronic values derived during this study are similar to those reported in the literature, indicating that, in this case, Tittabawassee River water quality did not influence the toxicity of ammonia to the species tested. (See also W87-06316 thru W87-06318) (Author's abstract)
W87-06317

SITE-SPECIFIC ACUTE AND CHRONIC TOXICITY OF AMMONIA TO DAPHNIA MAGNA STRAUS,
Dow Chemical U.S.A., Midland, MI. Health and Environmental Sciences.
F. M. Gersich, and D. L. Hopkins.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 5, p 443-447, May 1986. 3 tab, 15 ref.

Descriptors: *Tittabawassee River, *Ammonia, *Toxicity, *Water Pollution effects, *Water quality standards, Rivers, Michigan, Population exposure.

The acute and chronic toxicity of ammonia (expressed as un-ionized ammonia nitrogen, NH3-N) to Daphnia magna was determined in support of the development of site-specific water quality standards for ammonia in the Tittabawassee River at Midland, Michigan. The 48-h LC50 value (95% confidence interval) obtained was 2.94 (2.70 to 3.22) mg NH3-N/L. The 21-d chronic value, presented as the maximum acceptable toxicant concentration (MATC), was between 0.42 and 0.87 mg NH3-N/L. Expressing the chronic value as the geometric mean of 0.42 and 0.87 resulted in an MATC of 0.60 mg NH3-N/L. The toxicity values derived during this study were similar to those reported in the literature for D. magna. (See also W87-06316 thru W87-06317) (Author's abstract)
W87-06318

SUBLETHAL EFFECTS OF BIOLOGICALLY TREATED PETROLEUM REFINERY WASTEWATERS ON AGONISTIC BEHAVIOR OF MALE ORANGESPOTTED SUNFISH, LEPOMIS HUMILIS (GIRARD),
Oklahoma State Univ., Stillwater. Dept. of Zoology.
J. C. Petersen, S. L. Burks, and R. J. Miller.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 5, p 463-471, May 1986. 3 fig, 3 tab, 38 ref.

Descriptors: *Sunfish, *Water pollution effects, *Industrial wastewater, *Toxicity, *Sublethal effects, *Fish behavior, Population exposure, Wastewater, Fish, Oil refineries, Oil wastes, Biological wastewater treatment.

Pairs of orangespotted sunfish were exposed to oil refinery wastewaters in acute, nonlethal toxicity tests. Frequencies of agonistic behaviors (approaches, fin erections, tail beats, operculum spreads, chases, bites and avoidances) were determined initially after a 10-d exposure to control water and then again after a 10-d exposure to the wastewaters. Changes in frequency were compared with changes in frequency for pairs of fish exposed to control water for both 10-d periods. Pairs of fish were observed for 60 min following each of the two 10-d exposures. Frequencies during the initial 15 and 30 min of the period and during the entire 60-min period were determined. For wastewater-exposed fish, the frequency of each behavior generally decreased following the 10-d exposure to wastewater. For fish exposed only to the control water, each behavior generally increased in frequency following the second 10-d period. The change in frequency for wastewater-exposed fish was significantly ($p < 0.05$) different from that for control fish for approaches, fin erections, chases, bites and avoidances at one or more of the three lengths (15, 30 and 60 min) of observation. (Author's abstract)
W87-06320

POTENTIAL IMPACT OF SELECTED AGRICULTURAL CHEMICAL CONTAMINANTS ON A NORTHERN PRAIRIE WETLAND: A MICROCOSM EVALUATION,
Columbia National Fisheries Research Lab., MO.
B. T. Johnson.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 5, p 473-485, May 1986. 3 fig, 7 tab, 32 ref.

Descriptors: *Water pollution effects, *Wildlife habitats, *Limnology, *Agricultural chemicals, *Prairies, *Wetlands, Pesticides, Microcosms, Toxicity, Sediments, Plants, Invertebrates, Algae, Macrophytes, Growth, Productivity.

An aquatic, multicomponent microcosm simulating a northern prairie wetland was used to asses the

potential effects of six extensively used agricultural pesticides. 16 3-liter aquatic microcosms were treated with three concentrations of each of the pesticides carbofuran, fonofos, phorate, atrazine, treflan and triallate. The microcosm units were incubated for 30 d in an environmental chamber, with a 16-h light:8-h dark cycle, maintained at 20 C. The laboratory protocol was designed as an initial, rapid, economical screening test to determine the effect, but not the fate, of chemical contaminants in terms of toxicity, impaired productivity and community biochemical functions. Static acute toxicity tests with Daphnia magna and Chironomus riparius suggested that carbofuran, fonofos, phorate and triallate were very toxic to aquatic invertebrates. For D. magna the 48-h EC50 values were 48, 15, 19 and 57 microgram(ug)/L, respectively. Invertebrates viability tests indicated rapid changes in the toxicological persistence of these pesticides after microcosm interaction. Populations of D. magna were established in the 10 ug/L test concentration of carbofuran, phorate, triallate and fonofos at 1, 1, 14 and 28 d, respectively. Preexposure of the wetland sediments to either triallate or fonofos did not appear to change the relative toxicological persistence of each compound in the water column. Changes in pH, alkalinity, conductivity, dissolved oxygen, total nitrogen and total phosphorus were also observed with different pesticide treatments. Atrazine significantly reduced gross primary productivity and inhibited algal and macrophytic growth. The respiratory electron transfer system, phosphatase activity, oxygen consumption and mineralization of dissolved organic carbon were not significantly impacted by any of these pesticides in hydrosoils. However, the impact of atrazine, fonofos and triallate on invertebrates and plants in the microcosm - both key elements in wetland productivity - would suggest that caution be used in application of these pesticides in or near wetland habitats. (Author's abstract)
W87-06321

CHARACTERIZATION OF CHEMICAL WASTE SITE CONTAMINATION AND DETERMINATION OF ITS EXTENT USING BIOASSAYS,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5A.
W87-06322

DETERMINATION AND GENOTOXICITY OF NITROGEN HETEROCYCLES IN A SEDIMENT FROM THE BLACK RIVER,
Brigham Young Univ., Provo, UT. Dept. of Chemistry.
W. R. West, P. A. Smith, G. M. Booth, and M. L. Lee.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 6, p 511-519, June 1986. 3 fig, 5 tab, 18 ref.

Descriptors: *Pollutant identification, *Genotoxicity, *Aromatic compounds, *Nitrogen compounds, *Water pollution effects, *Sediments, *Black River, Industrial wastewater, Effluents, Ohio, Steel industry, Chromatography, DNA synthesis, Toxicity, Isolation.

The genotoxicity of nitrogen heterocycles isolated from a sediment taken from the Black River near Loraine, Ohio, in an area that received effluents from the coking ovens of a steel plant was studied. These compounds were isolated by gel permeation chromatography and silicic acid adsorption chromatography from the moderately polar fraction of an organic extract of this sediment. Two complex mixtures of secondary and tertiary nitrogen heterocycles containing three to five aromatic rings were characterized using capillary column gas chromatography with selective detection. Both mixtures induced significant unscheduled DNA synthesis in primary rat hepatocytes and accounted for essentially all of the genotoxicity of the fraction from which they were isolated. (Author's abstract)
W87-06323

EFFECT OF AGE ON SENSITIVITY OF DAPHNIA MAGNA TO CADMIUM, COPPER AND CYANAZINE,
Corvallis Environmental Research Lab., OR.
A. V. Nebeker, M. A. Cairns, S. T. Onjukka, and R. H. Titus.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 6, p 527-530, June 1986. 4 tab, 8 ref.

Descriptors: *Bioassay, *Bioindicators, *Daphnia, *Toxicity, *Water pollution effects, *Cadmium, *Copper, *Cyanazine, *Sensitivity, Population exposure, Age, Heavy metals, Sediments, Herbicides.

Daphnia magna were exposed to cadmium, copper and cyanazine to determine the relative sensitivities of several age groups: less than 4 h, less than 24 h, 1 d, 2 d, 3 d, 4 d, 5 d, and 6 d old. Mean cadmium 48-h EC50 values for each age group ranged from 23 to 164 microgram(ug)/L. Mean copper EC50 values ranged from 6 to 18 ug/L. Cyanazine EC50 values ranged from 53 to 106 mg/L for copper and 84 and 86 ug/L for cyanazine, respectively. These similar sensitivities indicate that older animals can be used in tests equally as well as younger animals, thus simplifying the recovery of daphnids in acute sediment toxicity tests. (Author's abstract)
W87-06324

TOXICITY OF PENTACHLOROPHENOL TO AQUATIC ORGANISMS UNDER NATURALLY VARYING AND CONTROLLED ENVIRONMENTAL CONDITIONS,
Environmental Research Lab.-Duluth, Monticello, MN. Monticello Ecological Research Station.
S. F. Hedtke, C. W. West, K. N. Allen, T. J. Norberg-King, and D. I. Mount.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 6, p 531-542, June 1986. 1 fig, 9 tab, 25 ref.

Descriptors: *Pentachlorophenol, *Water pollution effects, *Toxicity, *Aquatic animals, Organic compounds, Phenols, Population exposure.

The toxicity of pentachlorophenol (PCP) was determined in the laboratory for 11 aquatic species. Tests were conducted seasonally in ambient Mississippi River water and under controlled conditions in Lake Superior water. Fifty-one acute toxicity tests were conducted, with LC50 values ranging from 85 microgram(ug)/L for the white sucker Catastomus commersoni during the summer to greater than 7,770 ug/L for the isopod Asellus racovitzai during the winter. The effect of PCP on growth and/or reproduction was determined for seven species. The most sensitive chronically exposed organisms were the cladoceran Ceriodaphnia reticulata and the snail Physa gyrina. Both were adversely affected at the lowest concentrations tested, i.e., 4.1 and 26 ug/L, respectively. The duckweed Lemna minor was the least sensitive, with no apparent effects after exposure for 21 d to concentrations as high as 1,440 ug/L. The greatest variation in toxicity was due to species sensitivity. Within a given season there was as much as a 40-fold difference in LC50 values between species. For any one species, the maximum variation in LC50 between seasons was approximately 14-fold. There were also substantial differences in acute-chronic relationships, with acute/chronic ratios ranging from greater than 37 for C. reticulata to 1 for Simocephalus vetulus. It is suggested that the composition of the aquatic community should be the most important consideration in estimating the potential environmental effects of PCP. (Author's abstract)
W87-06325

TOXICITY OF PURE PENTACHLOROPHENOL AND CHLORINATED PHENOXYPHENOL IMPURITIES TO FATHEAD MINNOWS,
Columbia National Fisheries Research Lab., MO.
S. J. Hamilton, L. Cleveland, L. M. Smith, J. A. Lebo, and F. L. Mayer.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 6, p 543-552, June 1986. 4 tab, 43 ref.

Descriptors: *Pentachlorophenol, *Water pollution effects, *Toxicity, *Minnows, *Phenoxyphenols, Population exposure, Survival, Organic compounds, Fish physiology, Growth, Sublethal effects.

The toxicities of pure (greater than 99%) pentachlorophenol (PCP) and of a mixture of the major impurities in commercial PCP, composed mostly of octa and nonachlorophenoxyphenols (POPs), were evaluated in 90-d partial life-cycle toxicity tests with fathead minnows (Pimephales promelas Rafinesque). The exposure concentrations were 8 to 130 microgram(ug)/L for the pure PCP and 6 to 93 ng/L for the mixture of POPs. A spontaneous conversion of a 2-hydroxy isomer of nonachlorophenoxyphenol in the POPs mixture to octachlorodibenzodioxin was observed in the stock solution and exposure water during the POPs study. Pure PCP did not affect survival, growth or bone development at any concentration tested. The mixture of POPs did not affect survival but did reduce growth in fish exposed to 93 ng/L for 30 d and stimulated growth in fish exposed to 6 to 47 ng/L for 60 d or to 23 to 47 ng/L for 90 d. Bone development was significantly altered by exposure to POPs concentrations of 12 ng/L or higher; collagen concentration was elevated, and both hydroxyproline concentration (a key cross-linking amino acid in collagen) and bone density were reduced. Degeneration of the fins was noted at 30 d of exposure to 93 ng/L POPs, but fin development appeared nearly normal at 90 d. The sublethal effects of POPs at low concentrations, when compared with those of pure PCP, indicate that POPs may be a major contributor in the toxicity of commercial PCP to fish. (Author's abstract)
W87-06326

ROLE OF ARTIFICIAL BURROWS IN HEXAGENIA TOXICITY TESTS: RECOMMENDATIONS FOR PROTOCOL DEVELOPMENT,
Columbia National Fisheries Research Lab., MO.
M. G. Henry, D. N. Chester, and W. L. Mauck.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 6, p 553-559, June 1986. 2 fig, 2 tab, 19 ref.

Descriptors: *Mayflies, *Bioindicators, *Water pollution effects, *Toxicity, *Artificial burrows, Population exposure, Sensitivity, Leachates.

Hexagenia are an important component of fish and waterfowl diets, provide an ecological link in the conversion of detritus to usable nutrients and are useful test organisms for monitoring trends in aquatic contaminants. Consequently, Hexagenia bilineata were used in toxicity tests to determine their sensitivity to leachate from spent shale oil and to evaluate the influence of including artificial glass burrows in exposure chambers. Gill beat frequency and mortality were significantly higher ($p = 0.01$) in nymphs that were not afforded an opportunity to burrow than in those exposed to the toxicant but that had access to artificial burrows. Molting frequency was depressed in Hexagenia lacking burrows, and it was further decreased as the amount of toxicant increased. Thus, thigmotactic stress accentuated by the presence of shale oil leachate was relieved by including artificial burrows in the exposure chambers. The resulting toxicity data are more ecologically meaningful because the burrowing life history characteristic of the Hexagenia was addressed and incorporated into the test protocol. (Author's abstract)
W87-06327

TOXICOKINETICS OF FENVALERATE IN RAINBOW TROUT (SALMO GAIRDNERI),
Iowa State Univ., Ames. Dept. of Entomology.
S. P. Bradbury, J. R. Coats, and J. M. McKim.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 6, p 567-576, June 1986. 1 fig, 5 tab, 30 ref. DHHS/NIH Grant 2 S07 RR7034-18.

Descriptors: *Path of pollutants, *Isotope studies, *Water pollution effects, *Toxicokinetics, *Fenvalerate, *Trout, *Bioaccumulation, *Path of pollutants, Population exposure, Pyrethroids, Insecticides, Tissue analysis.

An in vivo rainbow trout (Salmo gairdneri) preparation was used to evaluate the gill uptake and toxicokinetics of (3H)fenvalerate ((R,S)-alpha-cyano-3-phenoxybenzyl (R,S)-2-(4-chlorophenyl)-3-methylbutyrate), a synthetic pyrethroid insecticide. Fish were exposed to technical-grade fenvalerate (0.28 or 23 ng/L) or an emulsifiable-concentrate formulation (16 ng/L) for 36 to 48 h. No significant effects of emulsifiers or fenvalerate concentration on uptake were observed. The overall mean gill uptake efficiency was determined to be 28.6 + or - 4.4%. Following 8- to 48-h depuration periods, carcass and bile contained 80 to 90% and 10 to 20% of the gill-absorbed doses, respectively. Urine, feces and blood each contained less than 2% of the dose. Significant excretion and blood transport of fenvalerate equivalents were completed within 8 to 12 h after termination of exposure. Specific tissues from trout exposed to 0.28 ng/L fenvalerate were analyzed for fenvalerate equivalents (7,000 pg/g), followed by fat (200 pg/g). Remaining tissues contained 15 to 45 pg/g. Analysis of biliary metabolites indicated that the glucuronide of 4'-HO-fenvalerate was the only significant degradation product. Results from the present study suggest that efficient gill uptake does not explain the extreme sensitivity of fish to fenvalerate. Rather, a low rate of biotransformation and excretion may play a significant role in the susceptibility of rainbow trout to the synthetic pyrethroid insecticides. (Author's abstract)
W87-06328

METHOXYCHLOR DISTRIBUTION, DISSIPATION, AND EFFECTS IN FRESHWATER LIMNOCORRALS,
Canadian Centre for Toxicology, Guelph (Ontario).
For primary bibliographic entry see Field 5B.
W87-06329

IMPACT OF METHOXYCHLOR ON FRESHWATER COMMUNITIES OF PLANKTON IN LIMNOCORRALS,
Guelph Univ. (Ontario). Dept. of Environmental Biology.
G. L. Stephenson, N. K. Kaushik, K. R. Solomon, and K. Day.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 6, p 587-603, June 1986. 12 fig, 5 tab, 35 ref.

Descriptors: *Water pollution effects, *Methoxychlor, *Plankton, *Limnology, *Toxicity, *Lakes, Biomass, Population exposure, Sensitivity.

Aquatic enclosures, or limnocorrals (5 x 5 x 5 m deep), installed in a 10-ha mesotrophic lake in southern Ontario were used to evaluate the impact of four concentrations of methoxychlor (300 and 3 microgram(ug)/L in 1981, and 50 and 5 ug/L in 1982) on plankton communities. Methoxychlor was acutely toxic at 300 ug/L to both the macrozooplankton (Cladocera and Copepoda) and microzooplankton (Rotifera). No recovery in macrozooplankton numbers was observed by the end of the experiment (119 d); however, densities of microzooplankton had recovered by 52 d to levels similar to those in the control corrals by the end of the experiment (145 d); however, nauplii and copepodites recovered by 55 and 100 d, respectively. Numbers of Chlorophyta were significantly lowered by 50 ug methoxychlor/L ($p < or = 0.05$). The observed numerical recovery at 41 d was due primarily to an increase in the density of Kurchneriella lunaris. The biomass of this group remained low in these treated corrals because, despite its numerical increase, K. lunaris contributed little to chlorophyte biomass. Although 5 ug methoxychlor/L was toxic only to Cladocera and copepodites, recovery occurred within 20 d. Methoxychlor at 3 ug/L had no observable effects on density of plankton or on community structure. The responses to methoxychlor of the various groups of plankton generally appear to be exposure-dependent, with Cladocera and Chlorophyta exhibiting the greatest sensitivity. (See also W87-06329) (Author's abstract)
W87-06330

BIOCONCENTRATION OF HYDROPHOBIC CHEMICALS IN FISH: RELATIONSHIP WITH MEMBRANE PERMEATION,
Amsterdam Univ. (Netherlands). Lab. of Environmental and Toxicological Chemistry.
For primary bibliographic entry see Field 5B.
W87-06332

EVALUATION OF THE ARCHIANNELID DINOPHILUS GYROCILIATUS FOR USE IN SHORT-TERM LIFE-CYCLE TOXICITY TESTS,
Battelle New England Marine Research Lab., Duxbury, MA.
For primary bibliographic entry see Field 5A.
W87-06336

RELATION OF SURVIVAL TO OTHER END-POINTS IN CHRONIC TOXICITY TESTS WITH FISH,
Columbia National Fisheries Research Lab., MO.
For primary bibliographic entry see Field 5A.
W87-06338

USE OF SIZE-DEPENDENT MORTALITY MODELS TO ESTIMATE REDUCTIONS IN FISH POPULATIONS RESULTING FROM TOXICANT EXPOSURE,
Marine Ecological Research, Inc., Tappan, NY.
D. T. Logan.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 8, p 769-775, August 1986. 2 tab, 16 ref.

Descriptors: *Mathematical models, *Model studies, *Fish populations, *Water pollution effects, *Toxicity, Growth, Population dynamics, Fish eggs, Larvae, Mortality, Risk assessment, Sublethal effects.

In populations in which the rate of early mortality depends primarily on the size of individuals, growth and size become important determinants of population dynamics. Models based on size and developed for fish populations can provide a means of integrating acute and chronic toxicological observations to predict changes in population size. These models predict population reductions resulting from lethality to eggs and larvae, reduced growth rate, reduced length at hatch and any behavioral or physiological changes that increase either size-dependent or size-independent mortality rates. The dependence of mortality rate on size may arise from developmental changes, size-selective predation, changing energy balances or a combination of these. The biological source of mortality may dictate its mathematical expression. Since the size-dependent mortality modeled here may arise from several common sources, it may be widespread. As a result, reductions in natural populations caused by sublethal toxic exposures may not be unusual. These results suggest that measuring sublethal reductions in early growth that result from toxic conditions may be a meaningful way of estimating potential risks to natural populations. (Author's abstract)
W87-06339

ASSESSMENT OF THE SAFETY OF DIOCTYL ADIPATE IN FRESHWATER ENVIRONMENTS,
Monsanto Co., St. Louis, MO.
J. D. Felder, W. J. Adams, and V. W. Saeger.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 8, p 777-784, August 1986. 5 tab, 22 ref.

Descriptors: *Bioaccumulation, *Fate of pollutants, *Water pollution effects, *Risk assessment, *Dioctyl adipate, *Biodegradation, Toxicity, Algae, Fish, Solubility, Daphnia, Sediments.

A safety assessment of dioctyl adipate (DOA) in freshwater environments was conducted. DOA is relatively insoluble in water and is likely to partition to sediment and biota in the aquatic environment. Biodegradation was found to be rapid and extensive under conditions simulating sewage systems and the natural environment. Measured environmental concentrations of DOA averaged less than 0.5 microgram(ug)/L in natural surface waters. DOA was not acutely toxic to algae and fish at or above its water solubility of 0.78 + or - 0.16 mg/L. It was acutely and chronically toxic to Daphnia magna at 480 to 850 and 24 to 52 ug/L, respectively. A bioconcentration study with bluegill showed that DOA is not an accumulative or persistent chemical in this species. The mean 28-d bioconcentration factor was 27. A comparison of the mean environmental water concentrations of DOA with laboratory chronic toxicity values for D. magna showed a safety margin of approximately three orders of magnitude. The conclusion drawn from this environmental safety assessment is that, under present use and disposal patterns, DOA presents a small hazard to the freshwater aquatic environment. (Author's abstract)
W87-06340

EFFECTS OF COPPER, NICKEL AND ZINC ON THREE SPECIES OF OREGON FRESHWATER SNAILS,
Corvallis Environmental Research Lab., OR.
A. V. Nebeker, A. Stinchfield, C. Savonen, and G. A. Chapman.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 9, p 807-811, September 1986. 2 tab, 17 ref.

Descriptors: *Water pollution effects, *Copper, *Nickel, *Zinc, *Snails, Heavy metals, Toxicity, Mortality, Population exposure.

Three snail species collected from western Oregon were exposed to metals: Juga plicifera and Lithoglyphus virens, which inhabit cool coastal streams, and Physa gyrina, which is found in Willamette Valley ponds. J. plicifera were exposed in flow-through laboratory tests to copper and nickel, L. virens were exposed to copper, and P. gyrina were exposed to nickel and zinc. J. plicifera had a 96-h LC50 (50% of the test group died) of 0.015 mg/L for copper and a no observed effect level (NOEL, mortality not significantly different from that in control groups) of 0.006 mg/L (30-d survival). J. plicifera had a 96-h LC50 for nickel of 0.237 mg/L and a NOEL of 0.124 mg/L. L. virens had a 96-h LC50 for copper of 0.008 mg/L and a NOEL of less than 0.008 mg/L. P. gyrina had a 96-h LC50 for nickel of 0.239 mg/L, a 96-h LC50 for zinc of 1.274 mg/L and a NOEL for zinc of 0.570 mg/L. (Author's abstract)
W87-06342

SIMULTANEOUS EVALUATION OF THE ACUTE EFFECTS OF CHEMICALS ON SEVEN AQUATIC SPECIES,
Eastman Kodak Co., Rochester, NY. Health and Environment Labs.
W. S. Ewell, J. W. Gorsuch, R. O. Kringle, K. A. Robillard, and R. C. Spiegel.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 9, p 831-840, September 1986. 1 fig, 6 tab, 59 ref.

Descriptors: *Analytical methods, *Water pollution effects, *Bioindicators, *Toxicity, *Aquatic animals, *Organic compounds, Cultures, Population exposure, Performance evaluation.

A cost-effective testing procedure is described that measures the acute aquatic effects of a single test chemical on seven aquatic species simultaneously: Asellus intermidius (pillbug); Daphnia magna (water flea); Dugesia tigrina (flatworm); Gammarus fasciatus (sideswimmer); Helisoma trivolvis (snail); Lumbriculus variegatus (segmented worm); and Pimephales promelas (fathead minnow). These species were chosen because of their ecological importance, diversity and amenability to laboratory culturing. Twenty-seven commercial inorganic and organic chemicals were tested using the simultaneous exposure procedure. The 96-h LC50 values were derived for each species and the results compared with literature values. The reproducibility of the results achieved using this testing procedure was shown to be very good. The results compare favorably with 96-h LC50 values from single-species tests. The susceptibility of test ani-

mals as a function of species and chemical compound was evaluated. Water fleas were found to be as susceptible as, or more so than, the other aquatic organisms for all compounds tested. The relative sensitivities of the other test species were found to be highly chemical dependent. (Author's abstract)
W87-06343

MARGINS OF UNCERTAINTY IN ECOTOXICOLOGICAL HAZARD ASSESSMENT,
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands).
For primary bibliographic entry see Field 5A.
W87-06344

EFFECTS OF COAL PILE LEACHATE ON TAYLOR BROOK IN WESTERN MASSACHUSETTS,
Massachusetts Univ., Amherst. Dept. of Environmental Sciences.
B. Tan, and R. A. Coler.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 10, p 897-903, October 1986. 3 fig, 3 tab, 18 ref.

Descriptors: *Coal mine wastes, *Acid water, *Water pollution effects, *Streams, *Leachates, *Mine wastes, *Runoff, *Toxicity, Heavy metals, Downstream, Taylor Brook, Fish, Aluminum, Mortality.

The metals in Taylor Brook, a second-order stream that receives the runoff and leachate from a coal pile, were analyzed and evaluated for toxicity. Al, Fe and Mn levels were highest immediately downstream from the coal pile at site 4, where the pH was 4.9. The water at this site was soft (41 ppm). Ca and Mg were predominantly unbound, yet maximum binding with organic acids occurred. The increase in SO4:NO3:Cl ratios showed that the effect was local rather than a consequence of acid precipitation alone. The 96-h LC50 values for guppies in water from sites 4 and 3 were 26 and 100%, respectively. The increase of Al (80-fold) was inversely proportional to pH, but this proportionality was more pronounced at site 4 than at site 3. The 36-h LC50 values obtained on the addition of Al and acidity to water from site 3 at the levels measured in water from site 4 were 24% and greater than 100%, respectively. When compared with the values (17% and 49%) derived for site 4 water, the data indicate that the toxicity was principally exerted by aluminum. Residual oxygen data also suggest that fish mortality was primarily a function of Al. Additions of Al (0.3 ppm) to Taylor Brook control site water resulted in increased toxicity to guppies, while added acidity (pH 4.5) had no marked effect. (Author's abstract)
W87-06346

ACUTE AND CHRONIC EFFECTS OF WATER QUALITY CRITERIA-BASED METAL MIXTURES ON THREE AQUATIC SPECIES,
Environmental Research Lab.-Duluth, MN.
R. L. Spehar, and J. T. Fiandt.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 10, p 917-931, October 1986. 2 fig, 8 tab, 44 ref.

Descriptors: *Water pollution effects, *Aquatic animals, *Metals, *Toxicity, Trout, Daphnids, Population exposure, Minnows, Survival, Water quality, Survival, Mortality, Synergistic effects.

Acute and chronic toxicity tests were conducted with three aquatic species to determine the effects of metals combined as mixtures at proposed water quality criteria concentrations and at multiples of the LC50 and maximum acceptable toxicant concentration (MATC) obtained from tests on six metals. These studies were the first part of a larger research effort to derive water quality criteria for combined pollutants by the U.S. Environmental Protection Agency. Arsenic, cadmium, chromium, copper, mercury and lead combined at criterion maximum concentrations caused nearly 100% mortality in rainbow trout and daphnids (Ceriodaphnia dubia) during acute exposures. Fathead minnows were not adversely affected at this or two times this concentration, although a mixture of four to eight times the maximum value caused 15 to 60% mortality. Metals combined at the criterion average concentrations significantly reduced production of daphnid young and growth of fathead minnows after 7 and 32 d, respectively. Embryo hatchability and survival of rainbow trout were reduced at four times this criterion but not at the criterion average concentration. Acute tests with metals mixed at multiples of the LC50 indicated that the joint action of the metals was more than additive for fathead minnows and nearly strictly additive for daphnids, based on toxic units calculated from the individual components of the mixture. Chronic tests showed that the joint action was less than additive for fathead minnows but nearly strictly additive for daphnids, indicating that long-term metal interactions may be different in fish than in lower invertebrates. Adverse effects were observed at mixture concentrations of one-half to one-third the MATC for fathead minnows and daphnids, respectively, suggesting that components of mixtures at or below no effect concentrations may contribute significantly to the toxicity of a mixture on a chronic basis. These results point out the need for additional studies to determine the type and degree of interaction of toxicants because single-chemical water quality criteria may not sufficiently protect some species when other toxicants are also present. (Author's abstract)
W87-06347

SURVIVAL OF DAPHNIA MAGNA AND HYALELLA AZTECA IN CADMIUM-SPIKED WATER AND SEDIMENT,
Corvallis Environmental Research Lab., OR.
A. V. Nebeker, S. T. Onjukka, M. A. Cairns, and D. F. Krawczyk.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 10, p 933-938, October 1986. 4 tab, 20 ref.

Descriptors: *Water pollution effects, *Cadmium, *Sediments, *Toxicity, *Daphnia, *Hyalella, Heavy metals, Mortality, Survival, Invertebrates, Adsorption.

Freshwater sediments and water were spiked with cadmium in the laboratory, and toxicity tests were conducted with the cladoceran Daphnia magna and the amphipod Hyalella azteca to determine if Cd in the sediment would cause increased toxicity. The 48-h LC50 values for Daphnia in tests without sediment were 36, 33, 24 and 40 microgram(ug)/L total Cd. Calculated free ion (Cd(2+)) LC50 values for the same tests were 28, 25, 18 and 31 ug/L. LC50 values (48-h) determined for total Cd (uncentrifuged water sample) in the sediment-containing beakers were 252, 69 and 122 ug/L for Daphnia. LC50 values for dissolved Cd (centrifuged 10,000 rpm) in the sediment-containing beakers were 61, 27 and 100 ug/L for Daphnia. Higher total Cd LC50 values indicate that Cd adsorbed to soluble organic material was not biologically available. The 96-h LC50 value in tests without sediment for Hyalella was 8 ug/L total Cd; two 10-d LC50 values were less than 2.8 and 6.0 ug/L. LC50 values (96-h) determined for Hyalella for total and dissolved Cd in tests with sediment were 74 and 6.6 ug/L, respectively; the 10-d LC50 for total Cd in tests with sediment was 80 ug/L. No significant mortality of Daphnia or Hyalella occurred in the flow-through tests in which sediment contained the same levels of Cd as in the static tests. Mortality was similar in beakers with and without Cd-spiked sediment, indicating that Cd in the sediment and adsorbed to organic materials was not available to cause increased mortality. (Author's abstract)
W87-06348

COMBINED AND SEPARATE EFFECTS OF CADMIUM, LEAD AND ZINC ON ALA-D ACTIVITY, GROWTH AND HEMOGLOBIN CONTENT IN DAPHNIA MAGNA,
Goeteborg Univ. (Sweden). Dept. of Zoophysiology.
R. Berglind.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 11, p 989-995, November 1986. 6 fig, 2 tab, 30 ref.

Descriptors: *Water pollution effects, *Daphnia, *Synergistic effects, *Cadmium, *Lead, *Zinc, Growth, Heavy metals, Tissue analysis, Inhibition, Enzymes, Population exposure.

The single and combined effects of cadmium, lead and zinc on delta-aminolevulinic acid dehydratase (ALA-D) activity, growth and hemoglobin content were studied in Daphnia magna. The ALA-D activity was enhanced by Cd and inhibited by Pb. The binary combinations, Pb:Cd and Pb:Zn, were powerful inhibitors of ALA-D. However, in the combination of the highest concentrations of lead and zinc the activity of ALA-D was enhanced. The stimulation by cadmium was abolished in the presence of zinc. All tertiary combinations of Pb, Cd and Zn inhibited ALA-D activity. Lead alone did not decrease the hemoglobin content in D. magna even at 260 microgram/L Pb, Zn were not more powerful in affecting the hemoglobin content than were the binary combinations. Growth was not affected by Cd, Pb or Zn in any of the combinations used. (Author's abstract)
W87-06353

DEVELOPMENT AND VALIDATION OF SITE-SPECIFIC WATER QUALITY CRITERIA FOR COPPER,
Environmental Research Lab.-Duluth, MN.
For primary bibliographic entry see Field 5A.
W87-06354

TOXICOLOGICAL STUDIES OF BENOMYL AND CARBENDAZIM IN RAINBOW TROUT, CHANNEL CATFISH AND BLUEGILLS,
Columbia National Fisheries Research Lab., MO.
D. U. Palawski, and C. O. Knowles.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 12, p 1039-1046, December 1986. 1 fig, 7 tab, 19 ref.

Descriptors: *Water pollution effects, *Path of pollutants, *Benomyl, *Carbendazim, *Fish physiology, *Toxicity, Metabolism, Catfish, Trout, Bluegills, Alkaline water, Tissue analysis, Bioaccumulation.

Benomyl and carbendazim exhibited high acute toxicity to channel catfish, Ictalurus punctatus (Rafinesque), but were much less toxic to rainbow trout, Salmo gairdneri (Richardson), and bluegills, Lepomis macrochirus (Rafinesque). Changes in water temperature, pH, and water hardness altered the acute toxicity to fish of both compounds; however, the alterations were less marked in channel catfish than in rainbow trout. Carbendazim injected intraperitoneally was not readily metabolized and was the major radioactive product excreted by the three fish species. The rapid depuration of radiocarbon into the containment water and the storage of residues in the gall bladder of each species indicated that both branchial and biliary excretion were major pathways for the elimination of carbendazim by fish. In the carbendazim residue dynamic studies, rainbow trout had the highest uptake rate constant and bioconcentration factor of the three species. Much less carbendazim was accumulated by channel catfish than by the other two species, but this residue level (0.44 microgram/g) appeared to be lethal after 48 h of exposure. The elimination rate constant and biological half-life of carbendazim were similar for rainbow trout and bluegills; however, the elimination rate constant was larger and the biological half-life shorter in channel catfish than in the other two species. It was concluded that benomyl and carbendazim were selectively toxic to channel catfish compared with rainbow trout and bluegill, but because of the instability of benomyl and the fast elimination of carbendazim, the possibility of these compounds excessively bioconcentrating in fish was remote. (Author's abstract)
W87-06357

DOWANOL, AN ENVIRONMENTALLY SAFE ADJUVANT,
Ottawa Univ. (Ontario). Dept. of Biology.
P.-Y. Caux, P. Weinberger, and D. B. Carlisle.
Environmental Toxicology and Chemistry

ETOCDK, Vol. 5, No. 12, p 1047-1054, December 1986. 10 fig, 1 tab, 36 ref.

Descriptors: *DOWANOL, *Water pollution effects, *Toxicity, Adjuvants, Biomass, Photosynthesis, Forests, Risk assessment, Field tests, Pesticides.

Pesticide spray formulations include a variety of adjuvants as wetting agents, surfactants or emulsifiers. DOWANOL TPM (tripropylene glycol methyl ether) is one such adjuvant in current common use in spray formulations of the insecticide fenitrothion. Unlike some other adjuvants tested, DOWANOL appears to have no significant toxicity for duckweed, Lemna minor L., an environmentally important aquatic plant, which was previously shown to be sensitive to some formulations. Four parameters were monitored, namely, biomass, photosynthetic function, adenosine triphosphate level and changes in the electrical potential of the bathing media. Reported concentrations of DOWANOL in forest pools after spraying are of the order of 1 microgram(ug)/ml. We have tested concentrations up to 956 ug/ml. The highest concentration produced significant functional impairment in the plants, which, however, recovered within 2 d in freshwater. Lower concentrations had no measurable effects. The threshold concentration for DOWANOL toxicity to Lemna is thus about three orders of magnitude higher than observed field concentrations, and we conclude that it therefore can be judged to be a relatively environmentally safe adjuvant. (Author's abstract)
W87-06358

SCREEN DEVICE TO ELIMINATE 'FLOATERS' IN DAPHNIA MAGNA TOXICITY TESTS,
Battelle Columbus Div., OH.
For primary bibliographic entry see Field 5A.
W87-06359

RELATIONSHIP BETWEEN AQUATIC TOXICITY QSARS AND BIOCONCENTRATION FOR SOME ORGANIC CHEMICALS,
Ontario Ministry of Labour, Toronto. Special Studies and Services Branch.
L. S. McCarty.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 12, p 1071-1080, December 1986. 2 fig, 2 tab, 42 ref.

Descriptors: *Water pollution effects, *Path of pollutants, *Bioaccumulation, *QSAR, *Toxicity, Organic compounds, Prediction, Model studies, Kinetics.

Aquatic toxicity testing is conducted largely by means of a single experimental protocol - the concentration-response toxicity test. This procedure has a number of well-known limitations resulting from the fact that the relationship between the waterborne toxicant concentration and the actual body toxicant concentration which is producing the observed biological response is unknown. Hence quantifying the influence of chemical potency, physical, chemical and biological factors and elapsed time on the outcome of toxicity tests is difficult. Interpretation, and even more significantly, predictability may be severely restricted. Using, and further quantifying, the links between octanol-water partition coefficients, bioconcentration and acute and chronic toxicity quantitative structure-activity relationships (QSARs) for narcotic organic chemicals has allowed the following conclusions to be made: (1) Establishing internal toxicant concentrations related to acute and chronic effects, as estimated in this paper, will allow the toxicological significance of body burdens of certain organic chemicals, both singly and in certain mixtures, to be determined; (2) Chemical potency, as determined in the exposed organism, appears to be essentially constant for each of the biological responses and organic chemical groups examined; (3) The acute and chronic QSARs discussed herein are all parallel, each having a slope of unity; (4) It appears, as a first approximation, that a one-compartment, first-order kinetics model could provide a quantitative means of studying aquatic toxicity test results, both retrospectively and prospectively; (5) Bioconcentration and toxicity kinetics appear to be similar, but the internal toxicant concentration endpoint is different, fixed for toxicity and variable for bioconcentration. (Author's abstract)
W87-06361

EMBRYONIC MORTALITY AND ABNORMALITIES OF AQUATIC BIRDS: APPARENT IMPACTS OF SELENIUM FROM IRRIGATION DRAINWATER,
California Univ., Davis. Dept. of Wildlife and Fisheries Biology.
H. M. Ohlendorf, D. J. Hoffman, M. K. Saiki, and T. W. Aldrich.
The Science of the Total Environment STENDL, Vol. 52, No. 1/2, p 49-63, June 1986. 1 fig, 6 tab, 59 ref.

Descriptors: *Bioaccumulation, *Path of pollutants, *Water pollution effects, *Selenium, *Toxicity, *Aquatic birds, *Mortality, *Reproduction, *Pathology, *Irrigation-return flow, Developmental abnormalities, San Joaquin Valley, California, Embryos, Chicks, Organ abnormalities, Skeletal abnormalities, Tissue analysis.

Severe reproductive impacts were found in aquatic birds nesting on irrigation drainwater ponds in the San Joaquin Valley of California. Of 347 nests studied to late incubation or to hatching, 40.6% had at least one dead embryo and 19.6% had a least one embryo or chick with an obvious external anomaly. The deformities were often multiple and included missing or abnormal eyes, beaks, wings, legs, and feet. Brain, heart, liver, and skeletal anomalies also were present. Mean Se concentrations in plants, invertebrates, and fish from the ponds were 22-175 ppm (dry weight), about 12-130 times those found at a nearby control area. Bird eggs (2.2-100 ppm) and livers (19130 ppm) also contained elevated levels of Se. Aquatic birds may experience similar problems in other areas where Se occurs at elevated levels. (Author's abstract)
W87-06390

HISTOPATHOLOGICAL EFFECTS OF PARAQUAT AND GILL FUNCTION OF PUNTIUS GONIONOTUS, BLEEKER,
Chulalongkorn Univ., Bangkok (Thailand). Dept. of Pharmacology.
P. Sinhaseni, and T. Tesprateep.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 2, p 308-312, February 1987. 1 fig, 1 tab, 14 ref.

Descriptors: *Histopathology, *Herbicides, *Sublethal effects, *Paraquat, *Thailand, *Water pollution effects, *Fish physiology, Pathology, Fish pathology, Population exposure, Fish, Pollutants, Pesticides, Gills.

The histopathological effects of Paraquat, a widely used herbicide, applied to Thai Silver barb, Puntius gonionotus, Bleeker, under laboratory conditions were presented. After 5 and 12 days of exposure to Paraquat, no abnormal behavior was noticed and none of the fish died before termination of the experiment. The gills were the only organ found to have histopathological changes following exposure at 4 milligrams/liter for 12 days. Cellular swelling of gill filaments, although it implies an early and reversible manifestation of injury, usually becomes apparent only after the critical damaging biochemical event and function derangement have occurred. The increased permeability of cell membrane with or without loss of intracellular reserves of energy may be involved. It was concluded that the exposure of 4 milligrams/liter of Paraquat for a longer period of time could cause detrimental effects in fish. (Wood-PTT)
W87-06425

SEASONAL TOXICITY OF AMMONIA TO FIVE FISH AND NINE INVERTEBRATE SPECIES,
Environmental Research Lab.-Duluth, Monticello, MN. Monticello Ecological Research Station.
J. W. Arthur, C. W. West, K. N. Allen, and S. F. Hedtke.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 2, p 324-331, February 1987. 1 tab, 17 ref.

Descriptors: *Ammonia, *Water pollution effects, *Toxicity, *Invertebrates, *Sensitivity analysis, *Rivers, *Seasonal variation, Fish, Pollutants, Sublethal effects, Amphipods, Caddisflies, Cladocera, Crayfish, Crustaceans, Clams, Mollusks, Mayflies, Aquatic insects, Anisopods, Snails, Catfish, Minnows, Sucker, Trout, Water temperature, Population exposure.

The relative sensitivity of fish and invertebrates to unionized ammonia in river water at ambient seasonal temperature was determined in a laboratory setting. The tested invertebrates included an amphipod, caddisfly larvae, a cladoceran, crayfish, fingernail clam, mayfly, anisopod and snails. The tested fish included channel catfish, fathead minnow, white sucker, walleye, and rainbow trout. Testing occurred during all four seasons at ambient river water temperatures. The rainbow trout was the most sensitive fish, while the most sensitive invertebrate was the fingernail clam. With exception of two mollusks and the cladoceran species, all other invertebrates were less sensitive than fish to the short-term ammonia exposures. No clear relationship was demonstrated between NH3 toxicity and water temperature. Literature comparisons of toxicity values were made where possible. The laboratory results will be used for comparison with field tests in the determination of water quality criteria. (Wood-PTT)
W87-06427

TOXICOLOGICAL EVALUATION OF THE LEACHATE FROM A CLOSED URBAN LANDFILL,
North Dakota State Univ., Fargo. Dept. of Pharmacognosy.
L. M. Radi, D. J. Kuntz, G. Padmanabhan, I. E. Berg, and A. K. Chaturvedi.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 2, p 337-344, February 1987. 2 tab, 32 ref.

Descriptors: *Leachates, *Landfills, *Water pollution effects, *Animal behavior, *Animal physiology, *Toxicity, *Solid waste disposal, *Heavy metals, *Waste disposal, Municipal wastes, North Dakota, Atomic absorption spectrophotometry, Gas chromatography, Neurobehavior, Pesticides, Groundwater pollution, Pollutants, Pesticides, Drinking water.

Leachate, water that picks up dissolved and/or particulate material as it percolates through solid waste, was obtained from a closed landfill which served a city population of about 60,000 in North Dakota and was evaluated for its toxicity to mice. Animals were given leachate as drinking water for 65 days, and general toxicity to selected end points was observed. Atomic absorption spectrophotometry was used in the determination of inorganic ions, while gas chromatographic techniques were used for the detection of various pesticides. The daily consumption of leachate affected spleen weight and neurobehavior of the mice. There was no significant difference in feed intake, liquid consumption or body weight gain relative to the control animals. The ratio of liver or kidney weight to body weight also did not change. The effects of exposure to leachate will depend on the amount and nature of the constituents of the leachate which varies with the source. Relative to tap water, the leachate given to the mice contained fairly high amounts of such metals as magnesium, arsenic, barium, chromium, lead, iron and cadmium. Organic pesticides were not detected. Levels of the metals were, however, several times higher in the leachate than the safe drinking level determined by the USEPA and some of these metals have the potential to produce undesirable effects on the nervous system, kidneys, liver and immune system. Studies on toxicity of leachates from landfills using animal models are necessary to predict toxicological consequences of contamination of groundwater by leachates. (Wood-PTT)
W87-06428

TOXICITY OF MIXTURES OF HEAVY METALS AND PETROCHEMICALS TO XENOPUS LAEVIS,

Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands). Lab. for Ecotoxicology, Environmental Chemistry, and Drinking Water.
D. de Zwart, and W. Slooff.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 2, p 345-351, February 1987. 3 tab, 10 ref.

Descriptors: *Synergistic effects, *Toxicity, *Heavy metals, *Petrochemicals, *Water pollution effects, *Mortality, *Toads, Amphibians, Hazardous materials, Environmental effects, Alcohols, Amines, Hydrocarbons, Petroleum hydrocarbons, Halogens, Lethal limit, Least squares method, Mathematical equations, Mathematical studies, Regression analysis, Comparison studies.

Further information is needed for the estimation of potential environmental hazards of mixtures of toxic chemicals. Special attention was given to petrochemical compounds which are often released into waters polluted with heavy metals. Acute tests on mixtures of alcohols, amines, hydrocarbons and halogenated carbons in combination with some heavy metals were described and discussed. The clawed toad, Xenopus laevis, was used as a test animal since this species is easy to culture and to maintain in a laboratory and its susceptibility to toxicants is comparable to that of fish. The toxicity of the individual compounds was expressed in milligrams/liter as the median lethal concentration after 48 hours (48h LC 50) which was calculated as a projection from the least square linear regression on log transformed nominal concentration data and probit transformed percent effective data. The toxicity of mixtures was calculated the same way, but concentration was entered as the sum of the fractions of the LC 50 values of the individual compounds. Relevant equations were presented. The interaction of compounds in simple equitoxic mixtures of heavy metals and amines resulted in an enhanced toxicity, whereas the combined toxicity of a mixture of hydrocarbons was less than additive. Alcohols and halogenated hydrocarbons acted approximately additively. Most combinations tested showed the expected addition or near addition of toxicity. (Wood-PTT)
W87-06429

TOXICITY OF 3,4-DICHLOROANILINE TO FATHEAD MINNOWS, PIMEPHALES PROMELAS, IN ACUTE AND EARLY LIFE-STAGE EXPOSURES,
Wisconsin Univ.-Superior. Center for Lake Superior Environmental Studies.
D. J. Call, S. H. Poirier, M. L. Knuth, S. L. Harting, and C. A. Lindberg.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 2, p 352-358, February 1987. 2 tab, 17 ref. EPA Cooperative agreements CR809234 and CR811590.

Descriptors: *Toxicity, *Dichloroaniline, *Water pollution effects, *Minnow, *Sublethal effects, *Mortality, Fish, Herbicides, Industrial wastes, Dye industry wastes, Pollutants, Lethal limit, Fish eggs, Hatching, Eggs, Acute-chronic ratio, Organic compounds, Effluents, Population exposure.

The tested chemical, 3,4-dichloroaniline (3,4-DCA), may enter surface waters as a contaminant in applications of agricultural herbicides, as a metabolite of several herbicides, or in industrial effluents from dye manufacturing plants. Acute toxicity tests were conducted with fathead minnows. Mortalities were recorded at 24, 48, and 96 hours and the median lethal concentration was estimated by the trimmed Spearman-Karber method. The effects at low concentrations in extended exposures on egg hatchability, early life, and physical characteristics including length, weight and appearance, were reported. An acute-chronic ratio (ACR) greater than 1,200 was obtained when the geometric mean of the maximum acceptable toxin concentration was taken as a chronic point estimate. This large an ACR for an industrial chemical is unusual; the majority of industrial organics having nonanesthetic effects tested previously had ACRs averaging about 10-12. It was concluded that 3,4-DCA must operate by a different and more toxic mode of action. (Wood-PTT)
W87-06430

EFFECT OF INCREASING COPPER AND SALINITY ON GLYCEROL PRODUCTION BY DUNALIELLA SALINA,
Montclair State Coll., Upper Montclair, NJ. Dept. of Biology.
B. Lustigman, J. M. McCormick, G. Dale, and J. J. A. McLaughlin.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 2, p 359-362, February 1987. 3 tab, 10 ref.

Descriptors: *Copper, *Salinity, *Water pollution effects, *Algae, *Sublethal effects, *Glycerol, *Mortality, *Algal growth, *Algal toxins, *Toxicity, *Flagellates, Metals, Trace elements, Trace levels, Heavy metals, Algicides, Populations, Plant populations, Ions, Chemical properties, Growth stages, Cultures.

Dunaliella salina, a green marine flagellate, is able to grow in waters which vary greatly in salinity due to its ability to form glycerol as its main storage product. Copper is an essential trace element needed in small quantities by algae for plastocyanin production, but which at high concentrations acts as an algicide. The effects of lethal and sublethal concentrations of copper on growth and glycerol production in Dunaliella salina were examined. Cultures of D. salina showed a decrease in cell density starting with 5 ppm Cu(2+). After a marked decrease in population with concentrations up to 30 ppm Cu(2+), leveling off of the effect was observed. The maximum tolerated Cu(2+) concentration was 50 ppm. As salinity increased, so did resistance to the lethal effects of copper. The most statistically significant effect on glycerol per cell was its increase with increasing salinity. Concomitantly, there was a smaller, but still statistically significant, increase due to copper concentration with the result that the addition of copper to cultures produced an increase in the amount of glycerol per cell at both salinities employed. Since sublethal concentrations of copper delayed log phase growth, the resulting cells had a higher concentration of glycerol. However, while glycerol concentration per cell increased, cell density decreased so that total yield of glycerol was not greater with copper treatment than in the non-treated controls. (Wood-PTT)
W87-06431

SIZE DISTRIBUTION OF AUTOTROPHY AND MICROHETEROTROPHY IN RESERVOIRS: IMPLICATIONS FOR FOODWEB STRUCTURE,
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 2H.
W87-06434

AQUATIC COMMUNITY RESPONSE TO TECHNIQUES UTILIZED TO RECLAIM EASTERN U.S. COAL SURFACE MINE - IMPACTED STREAMS,
Tennessee Valley Authority, Knoxville.
L. B. Starnes.
IN: The Restoration of Rivers and Streams: Theories and Experience, Butterworth Publishers, Boston, Massachusetts. 1985. p 193-222, 10 fig, 2 tab, 53 ref.

Descriptors: *Aquatic environment, *Ecosystems, *Water pollution effects, *Ecological effects, *Coal mining, *Tennessee, *Ollis Creek, *Elkins, *West Virginia, Environmental effects, Streams, Acid mine drainage, Surface mines.

Coal mining and associated processing activities are required to use best available technologies to minimize impacts to air, water, and land. Mined areas must be reclaimed. Many older mined areas were poorly operated from an environmental standpoint and were left to be reclaimed by natural processes. This lack of environmental foresight culminated in such problems as acid mine drainage, mine subsidence, mine and refuse fires, and barren and highly erodable land. While these problems emanate from both abandoned strip and underground mines, this paper concentrates on methods to restore abandoned surface coal mines in the eastern United States. The Ollis Creek (Tennessee) and Elkins (West Virginia) projects indicated that aquatic recovery may occur at mine reclamation sites, but even with remedial or intensive reclamation complete recovery will be slow. Previous studies have reported twenty-four years to full biological recovery in nonacid drainage situations. For abandoned mines, this is probably the fastest possible natural recovery; and unfortunately, problems such as acid or sedimentation would extend recovery into additional decades. For aquatic resources, this is unacceptable when total watershed reclamation schemes can not only ameliorate water quality problems but also enhance aquatic biological recovery. The greatest ecological recovery in the receiving streams within the projects evaluated has occurred when reclamation methodology has simultaneously treated both drainage and vegetation problems, and was based on careful planning of site-specific problems. While the exception, not the rule was examined for the majority of projects (especially in the East), reclamation efforts have been concentrated at the abandoned mine with little regard for amelioration or elimination of in-stream or secondary impacts. The tacit assumption that successful revegetation indicates successful aquatic recovery may not be true. (See also W87-06435) (Lantz-PTT)
W87-06442

GAS EXCHANGE AND GROWTH IN WHEAT AND BARLEY GROWN IN SALT,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.
For primary bibliographic entry see Field 2I.
W87-06532

DIFFERENTIAL EFFECTS OF K(+) AND NA(+) ON OXYGEN EVOLUTION ACTIVITY OF PHOTOSYNTHETIC MEMBRANES FROM TWO HALOPHYTES AND SPINACH,
Australian National Univ., Canberra. Dept. of Botany.
For primary bibliographic entry see Field 2I.
W87-06533

USE OF CONCENTRATED MACRONUTRIENT SOLUTIONS TO SEPARATE OSMOTIC FROM NACL-SPECIFIC EFFECTS ON PLANT GROWTH,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.
For primary bibliographic entry see Field 2I.
W87-06535

ION REGULATION IN THE ORGANS OF CASUARINA SPECIES DIFFERING IN SALT TOLERANCE,
Australian National Univ., Canberra. Dept. of Forestry.
For primary bibliographic entry see Field 2I.
W87-06537

REDUCTION BY GA3 OF NACL-INDUCED INHIBITION OF GROWTH AND DEVELOPMENT IN SUAEDA USSURIENSIS,
Qufu Teachers Univ. (China). Dept. of Biology.
For primary bibliographic entry see Field 2I.
W87-06538

ROLE OF LEAF AREA DEVELOPMENT AND PHOTOSYNTHETIC CAPACITY IN DETERMINING GROWTH OF KENAF UNDER MODERATE SALT STRESS,
California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 2I.
W87-06539

EFFECT OF TEMPERATURE AND LIGHT (FLUENCE RATE) ON THE COMPOSITION

OF THE TOXIN OF THE CYANOBACTERIUM MICROCYSTIS AERUGINOSA (UV-006),
Orange Free State Univ., Bloemfontein (South Africa). Dept. of Botany.
A. J. van der Westhuizen, J. N. Eloff, and G. H. J. Krueger.
Archiv fuer Hydrobiologie AHYBA4, Vol. 108, No. 2, p 145-154, December 1986. 3 fig, 1 tab, 35 ref.

Descriptors: *Algal growth, *Cyanophyta, *Cultures, *Toxicity, *Temperature effects, *Light effects, *Microcystis, Hartbeespoort Dams, South Africa, Toxins, Peptides, Amino acids, Blue-green algae, Chemical analysis.

The chemical composition of the toxin of Microcystis aeruginosa grown at different temperatures and fluence rates was investigated in an attempt to explain the influence of culture conditions on toxicity. The sample, which originated from Hartbeespoort Dam, South Africa was purified and axenic cells were cultured under sterile and controlled laboratory conditions. The toxin was extracted from freeze-dried cells and subsequently purified by gel chromatography and HPLC. Several toxic fractions were achieved. Changes in temperature (and, to a lesser extent, fluence) caused a change in the relative peptide composition of the toxin as regards the two major constituents, A and B. The toxin of cells grown at 16 C contained a third major peptide which at 20 C constituted only a minor component of the toxin and gradually disappeared with increasing temperature. The effect of temperature and fluence rate on amino acid composition of the toxic peptides A and B was investigated with regard to alanine, leucine, beta-methylaspartic acid, and glutamic acid only. Results strongly suggest that the amino acid composition remained unchanged. A change in total toxicity is thus related to the concentration of the constituent peptides and not to structural changes of the peptides. Due to the lack of knowledge on the inherent potency of the individual peptides it is uncertain to what extent the observed changes in relative peptide composition had contributed to the variation in total toxicity. (Author's abstract)
W87-06555

PHOTOSYNTHESIS OF SIZE-FRACTIONATED PHYTOPLANKTON POPULATION IN HYPERTROPHIC LAKE KASUMIGAURA, JAPAN,
National Inst. for Environmental Studies, Tsukuba (Japan). Environmental Biology Div.
For primary bibliographic entry see Field 2H.
W87-06560

5D. Waste Treatment Processes

NEW DESIGN PROCEDURE FOR ACTIVATED SLUDGE BASED ON ACTIVE MASS,
Vanderbilt Univ., Nashville, TN. Dept. of Civil and Environmental Engineering.
A. T. Watkin, and W. W. Eckenfelder.
Environmental Technology Letters ETLEDB, Vol. 6, No. 10, p 421-428, October 1985. 3 fig, 1 tab, 6 ref.

Descriptors: *Wastewater treatment, *Activated sludge process, *Mixed liquor solids, *Design criteria, Mass balances, Equations, Kinetics, Wastewater facilities.

Design equations are formulated for the activated sludge process based on degradable and non-degradable fraction of the mixed liquor volatile suspended solids. By appropriate mass balances, relationships are developed for the degradable and active fractions based on sludge age. These relationships are in more usable form than relationships based on the F/M ratio. Incorporation of the active fraction in kinetic design equations results in more accurate estimates of excess biological solids generation and required hydraulic residence time. (Author's abstract)
W87-05922

ELECTRON MICROSCOPIC EVALUATION OF BACTERIA INHABITING ROTATING BIOLOGICAL CONTACTOR BIOFILMS DURING VARIOUS LOADING CONDITIONS,
New Hampshire Univ., Durham. Dept. of Civil Engineering.
N. E. Kinner, D. Maratea, and P. L. Bishop.
Environmental Technology Letters ETLEDB, Vol. 6, No. 10, p 455-466, October 1985. 7 fig, 3 tab, 32 ref. NSF Grant DEB 811 4819.

Descriptors: *Rotators, *Biofilms, *Bacteria, *Organic loading, *Wastewater treatment, *Electron microscopy, Wastewater facilities, Morphology, Ultrastructure, Oxygen deficit, Poly-beta-hydroxybutyrate, Bacterial physiology, Nitrification.

The biofilms growing in all compartments of two rotating biological contactors, subjected to various organic loading rates during treatment of municipal wastewater, were examined by transmission electron microscopy. The morphological and ultrastructural characteristics of the biofilms correlated closely with the compartmental organic loading rate to which they were exposed. At high organic loading rates, oxygen limitations were indicated by the presence of large numbers of cells with poly-beta-hydroxybutyrate (PHB) and sulfur-like inclusions. As the loading rate decreased there was a decrease in PHB and sulfur-like storage in the biofilm bacteria. At low loading rates, prosthecate bacteria were the predominant biofilm constituents. In compartments where nitrification occurred, bacteria that possessed extensive cytomembranes and convoluted cell surfaces predominated. (Author's abstract)
W87-05924

OPTIMAL CONTROL OF THE COMPLETE-MIX ACTIVATED SLUDGE PROCESS,
Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Abt. fuer Angewandte Systemanalyse.
D. Brune.
Environmental Technology Letters ETLEDB, Vol. 6, No. 11, p 467-476, November 1985. 4 fig, 13 ref, 1 append.

Descriptors: *Activated sludge process, *Process control, *Mathematical models, *Computer models, *Wastewater treatment, Equations, Optimization, Flow rates, Biomass, Aeration.

By applying optimal control theory to a simple model of the activated sludge process, an optimal control strategy for the recycle flow rate was developed. Simulation of the controlled system showed that for this specific plant the biomass concentration in the aeration basin could be lowered significantly, while a sharp increase was necessary only at peak values of the incoming load. Keeping the model complexity low enough to allow the corresponding model equations to be solved analytically led to additional insights into model behavior and avoided numerical instabilities sometimes occurring in complex computer models. (Author's abstract)
W87-05925

PROPAGATION OF HYDRAULIC DISTURBANCES AND FLOW RATE RECONSTRUCTION IN ACTIVATED SLUDGE PLANTS,
Lund Univ. (Sweden). Dept. of Automatic Control.
G. Olsson, and J. P. Stephenson.
Environmental Technology Letters ETLEDB, Vol. 6, No. 12, p 536-545, December 1985. 5 fig, 6 ref.

Descriptors: *Wastewater treatment, *Hydrodynamics, *Model studies, *Activated sludge, *Hydraulic models, *Process control, Wastewater treatment facilities, Design criteria, Flow rates.

Hydraulic propagation through activated sludge systems is considered. Non-linear dynamic hydraulic models were developed and verified using plant data. These models were used to calculate intermediate flow rates for control purposes. The consequences of man-made hydraulic disturbances in association with weir design lead to a discussion of how the hydraulics influence both design and operation of treatment plants. (Author's abstract)
W87-05930

PRACTICAL EXPERIENCES WITH A NEW ON-LINE BOD MEASURING DEVICE,
Gesamthochschule Siegen (Germany, F.R.). Inst. fuer Mechanik und Regelungstechnik.
For primary bibliographic entry see Field 7B.
W87-05931

OPTIMAL PERIODIC CONTROL OF A STEEP-FEED ACTIVATED SLUDGE PLANT,
Fachhochschule fuer Wirtschaft, Pforzheim (Germany, F.R.).
H. Stehfest.
Environmental Technology Letters ETLEDB, Vol. 6, No. 12, p 556-565, December 1985. 8 fig, 5 ref.

Descriptors: *Model studies, *Wastewater treatment, *Activated sludge process, *Process control, *Aeration ponds, Wastewater facilities, Design criteria, Fluid dynamics, Hydraulic models, Calibrations, Optimization, Flow rates, Performance evaluation.

An activated sludge plant was investigated that had two aeration basins in series, and where both influent and recycle stream could be distributed arbitrarily between the two basins. A 7th-order dynamic model of the plant was developed, calibrated, and validated. The optimal control was calculated by means of an iterative technique based on the assumption that the input was periodic with a period of one day. Computational results obtained so far indicate that a substantial improvement of the performance can be obtained by appropriately controlling the total recycle flow rate and the distribution of the influent and recycle flow. (Author's abstract)
W87-05932

MODELLING THE ENERGY BALANCE OF WASTEWATER TREATMENT PLANTS,
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Siedlungswasserwirtschaft.
B. Kordes.
Environmental Technology Letters ETLEDB, Vol. 6, No. 12, p 566-575, December 1985. 13 fig, 2 tab, 17 ref.

Descriptors: *Model studies, *Wastewater treatment, *Computer models, *Simulation, *Wastewater facilities, *Energy consumption, Process control, Energy, Algorithyms.

A computer model to simulate the weekly and monthly energy demand of wastewater treatment plants is described. The input data required, some algorithms, and some results are presented. A case study shows that it is not yet possible to simulate the energy consumption of a plant over a given data period without calibrating the model upon some data set. In an example the effects of changes in the treatment process on energy balance of the plant are simulated. (Author's abstract)
W87-05933

SELF-TUNING CONTROL OF THE ACTIVATED SLUDGE PROCESS,
Florence Univ. (Italy). Dept. of Systems and Computer Science.
S. Marsili-Libelli, R. Giardi, and M. Lasagni.
Environmental Technology Letters ETLEDB, Vol. 6, No. 12, p 576-583, December 1985. 7 fig, 14 ref.

Descriptors: *Wastewater treatment, *Controllers, *Model studies, *Activated sludge process, *Process control, *Algorithms, *Dissolved oxygen, Wastewater facilities, Simulation, Sanitary engineering, Performance evaluation, Engineering.

The application of two adaptive controllers (algorithms) to the activated sludge process is described and their advantages and disadvantages are discussed in relation to dissolved oxygen regulation. The two controllers were a minimum variance integral (MVI) controller and a proportional-inte-

gral-derivative self-tuner (PID-ST). The PID-ST is shown (through simulation) to be superior the MVI for the activated sludge process, although the latter is an excellent controller for linear systems. The sparse knowledge of the system dynamics that is required to mechanize the controller, together with realistic assumptions on the process model, make the results credible enough to form a reliable basis for further engineering experimentation and applications. (Rochester-PTT)
W87-05934

ANAEROBIC PROCESS CONTROL BY BICARBONATE MONITORING,
Istituto di Ricerca sulle Acque, Bari (Italy).
A. Rozzi, A. C. Di Pinto, and A. Brunetti.
Environmental Technology Letters ETLEDB, Vol. 6, No. 12, p 594-601, December 1985. 4 fig, 21 ref.

Descriptors: *Wastewater treatment, *Anaerobic digestion, *Process control, *Bicarbonates, *Monitoring, Wastewater facilities, Equation, Alkalinity, Hydrogen ion concentration, Liquors, Carbon dioxide, Automation.

The advantages of bicarbonate monitoring for anaerobic digester process control are outlined and the available methods for manual and on-line analyses are described. Five equations that must be considered when dealing with bicarbonate in anaerobic digesters are: the inorganic carbon balance, Henry's law, the first bicarbonate equilibrium constant, and the ion and alkalinity balances. Several methods were developed for determining the bicarbonate concentration in anaerobic digester liquors; parameters employed include the alkalinity balance, in which bicarbonate alkalinity is calculated from total alkalinity and volatile fatty acid concentrations; a simpler method based on titration to pH 5.75; an inorganic carbon method; a titration and back-titration method; a method based on bicarbonate destruction by acid addition; and a method based on the evolved CO2. Among the available process parameters that could be used, bicarbonate alkalinity seems to be one of the most promising; several analytical methods are available that can be automated easily by using relatively inexpensive instruments ($1000-2000). (Rochester-PTT)
W87-05935

COMPOSITION OF WASH-WATERS FROM DRIED VINE-FRUIT,
Commonwealth Scientific and Industrial Research Organization, North Ryde (Australia). Div. of Food Research.
For primary bibliographic entry see Field 5A.
W87-05937

REMOVAL OF CHROMIUM FROM INDUSTRIAL EFFLUENTS BY ADSORPTION ON SAWDUST,
Roorkee Univ. (India). Dept. of Civil Engineering.
H. C. P. Srivastava, R. P. Mathur, and I. Mehrotra.
Environmental Technology Letters ETLEDB, Vol. 7, No. 1, p 55-63, January 1986. 9 fig, 4 tab, 16 ref.

Descriptors: *Chemical processes, *Wastewater treatment, *Effluents, *Industrial wastewater, *Sawdust, *Adsorption, *Chromium, Structural models, Wastewater facilities, Kinetics, Thermodynamics, Chemical oxygen demand, Langmuir equation, Performance evaluation.

Detailed studies were conducted in a bench scale model reactor system on the kinetics and thermodynamics of the process of adsorption of Cr onto sawdust. Synthetic Cr wastes (potassium dichromate) at pH 6.0 were employed. Equilibria data can be represented by the Langmuir equation. Chemical interaction between dichromate and sawdust results in chemisorption of chromate ions on sawdust. The kinetics indicate that the initial monolayer formation or physical sorption is complete within the first 3 hr and solid phase reaction occurs somewhat later. Adsorption of chromate ions depends on initial concentrations of sorbate and sorben and time of contact. Adsorption of Cr(VI) on sawdust is not pH dependent. The only disadvantage of the present process observed is increased chemical oxygen demand resulting from leaching out of lignin and cellulose from the sawdust. (Rochester-PTT)
W87-05940

PHYSICO-CHEMICAL TREATMENT OF DOMESTIC WASTEWATER,
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Dept. of Civil Engineering.
S. Farooq, and A. Bari.
Environmental Technology Letters ETLEDB, Vol. 7, No. 2, p 87-98, February 1986. 9 fig, 1 tab, 20 ref.

Descriptors: *Wastewater treatment, *Effluents, *Physicochemical treatment, *Domestic wastes, *Wastewater treatment, Lime precipitation, Ozonation, Secondary effluents, Primary treatment, Bacteria, Viruses, Dissolved oxygen, Dissolved solids, Hardness, Phosphorus, Heavy metals, Turbidity, Comparison studies.

Lime precipitation and ozonation, lime precipitation followed by ferrate treatment, filtration, and ozonation, and ferrate treatment followed by filtration and ozonation were compared as complete treatment for domestic wastewater. Lime precipitation followed by ozonation produces an effluent that is comparable in many qualities to secondary effluent. The effluents from the other two processes were equal to or better than secondary effluent. Based on the present results, lime treatment followed by ozonation is suggested for upgrading primary treatment in areas where lime and energy are readily available at competitive rates and sludge disposal is no problem. Application of ozone would significantly reduce the bacterial and viral populations while adding dissolved oxygen to the effluent. Other advantages of lime precipitation at high dosage include reduction in total dissolved solids, hardness, phosphorus, heavy metals, turbidity, and bacterial population. (Rochester-PTT)
W87-05942

HEAVY METAL, BACTERIAL AND VIRAL CONTAMINATION OF SEWAGE SLUDGES IN OXIDATION PONDS (CHARGES EN METAUX LOURDS, BACTERIES ET VIRUS, PRESENTES DANS LES BOUES D'UNE STATION D'EPURATION PAR LAGUNAGE NATUREL),
Ecole Nationale de la Sante Publique, Rennes (France). Lab. de Genie Sanitaire.
J. Carre, D. Baron, M. Legeas, and J. Maurin.
Environmental Technology Letters ETLEDB, Vol. 7, No. 2, p 119-127, February 1986. 1 fig, 6 tab, 13 ref.

Descriptors: *Pollutant identification, *Wastewater treatment, *Waste disposal, *Heavy metals, *Bacteria, *Viruses, *Oxidation ponds, France, Salmonella, Fecal bacteria, Land application, Cost analysis.

After 9 yr of operation, the sludge accumulation in a sewage treatment plant at Chapelle-Thouarault (15 km W of Rennes, France), which consists of four ponds, equipped with a primary settling tank, is substantial. The agricultural value of the sludge is reduced greatly by the high level of mineralization. Most of the heavy metal and viral contamination is found in the first pond. Notwithstanding prolonged storage time, the load of fecal bacteria remains high. The degree of contamination with Salmonella is low and limited to the first pond. The agricultural value of these sludges is poor and their land application will bring minimal benefit, but do little harm to the natural environment. (Author's abstract)
W87-05944

EFFECT OF THREE SLUDGE PROCESSING OPERATIONS ON THE FATE AND LEACHABILITY OF TRACE ORGANICS IN MUNICIPAL SLUDGES,
Environmental Protection Service, Burlington (Ontario). Waste Water Technology Centre.
T. W. Constable, L. J. Taylor, and R. J. Rush.
Environmental Technology Letters ETLEDB, Vol. 7, No. 3, p 129-140, March 1986. 3 fig, 5 tab, 5 ref.

Descriptors: *Wastewater treatment, *Fate of pollutants, *Sludge digestion, *Municipal wastes, *Heat treatment, *Trace organics, *Anaerobic digestion, *Polymer addition, Leaching, Performance evaluation.

The effects of heat treatment, anaerobic digestion, and anaerobic digestion with polymer addition on the mass in the solid and liquid fractions and leachability of trace organic contaminants in a municipal wastewater treatment plant sludge were evaluated. In general, heat treatment was the most effective method for reducing both total contaminant mass and leachability, whereas digestion with polymer addition was the most effective for reducing contaminant mass in the liquid fraction. (Author's abstract)
W87-05945

PARASITOLOGICAL STUDY OF WASTEWATER SLUDGE,
Nancy-1 Univ. (France). Faculte de Pharmacie.
J. Schwartzbrod, M. T. Thevenot, J. Collomb, and J. M. Baradel.
Environmental Technology Letters ETLEDB, Vol. 7, No. 3, p 155-162, March 1986. 2 fig, 4 tab, 26 ref.

Descriptors: *Wastewater treatment, *Parasites, *Sludge, *Nematodes, *Cestodes, *Eggs, *Anaerobic digestion, *Liming, *Ferric chloride treatment, *Composting, Ascaris.

A parasitological study was made of different stages of treatment and post-treatment sludge from a wastewater treatment plant: during treatment, after storage, and during composting. Out of 157 samples, 69% were positive for Nematode eggs and/or Cestode eggs. Anaerobic digestion of sludge had little effect on helminth egg recovery, but lime and ferric chloride treatment reduced the number of eggs found in sludge samples. Samples of sludge stored for 1 or 2-3 years were all positive, but after 4 yr storage no helminth eggs were found. After 120 days composting helminth eggs were still recovered. Although compost and stored sludge were positive, no Ascaris eggs tested showed any indication of viability. (Author's abstract)
W87-05947

SEMI-MICRO DETERMINATION OF C.O.D. ON FISH FILLETING WASTEWATER,
Centro de Investigaciones de Tecnologia Pesquera, Mar del Plata (Argentina).
For primary bibliographic entry see Field 5A.
W87-05950

INVESTIGATION OF HYDROXAMIC ACIDS FOR THE EXTRACTION OF CHROMIUM(III) FROM LEATHER WASTE AND THE POSSIBLE RE-USE OF THE EXTRACTED CHROMIUM IN THE TANNING INDUSTRY,
University Coll., Dublin (Ireland). Dept. of Chemistry.
D. A. Brown, W. K. Glass, M. Rasul Jan, and R. M. W. Mulders.
Environmental Technology Letters ETLEDB, Vol. 7, No. 5, p 283-288, May 1986. 4 tab, 14 ref. EEC Contract ENV 654 EIR(H)/642-NB.

Descriptors: *Wastewater treatment, *Recycling, *Chelation, *Extraction, *Chromium, *Tannery wastes, *Hydroxamic acids, *Industrial wastewater, Leather, Cost analysis, Energy, Heavy metals.

Nine hydroxamic acid chelating agents were investigated for the extraction of chromium(III) from chrome tanned leather waste. Benzohydroxamic acid (BHA) was the most suitable, and preliminary experiments showed that the extracted chromium(III) has potential tanning capacity. Approximately 90% of BHA was recovered. This method has potential for application to environ-

mental and industrial problems concerning chromium waste, but is at present economically unattractive because of the high BHA/Cr ratio required and the energy cost of the recycling process. (Author's abstract)
W87-05952

EFFECT OF NUTRIENT ADDITION ON PERFORMANCE OF ANIMAL WASTE FED STABILIZATION PONDS,
Roorkee Univ. (India). Dept. of Civil Engineering.
R. Bhargava, A. K. Shrivastava, R. P. Mathur, and J. P. Singh.
Environmental Technology Letters ETLEDB, Vol. 7, No. 6, p 319-324, June 1986. 4 fig, 2 tab, 11 ref.

Descriptors: *Wastewater treatment, *Animal wastes, *Nutrients, *Cattle, *Stabilization ponds, *Biochemical oxygen demand, Primary productivity, Primary wastewater treatment, Plant physiology, Nitrogen, Phosphorus, Magnesium, Boron, Engineered ecosystems.

Glass aquariums (45 x 30 x 30 cm) were used to represent waste stabilization ponds of the type commonly used in developing countries. The influent was raw cattle dung waste slurry. The various tanks were fed with nutrients in varying concentrations and the production (P), respiration (R), P/R ratio, and efficiency of total biochemical oxygen demand removal were observed. Controlled dosages of N, P, Mg, and B were helpful in increased production and increased treatment efficiency. It is suggested that waste stabilization ponds be treated as 'Engineered Ecosystems' to increase the efficiency of treatment. (Rochester-PTT)
W87-05953

ANAEROBIC DIGESTION OF STILLAGE FROM A PILOT SCALE WOOD-TO-ETHANOL PROCESS: I. STILLAGE CHARACTERISATION,
New Zealand Forest Service, Rotorua. Forest Research Inst.
I. J. Callander, T. A. Clark, P. N. McFarlane, and K. L. Mackie.
Environmental Technology Letters ETLEDB, Vol. 7, No. 6, p 325-334, June 1986. 2 fig, 4 tab, 34 ref.

Descriptors: *Wastewater treatment, *Anaerobic digestion, *Stillage, *Wood wastes, *Wood-ethanol process, Pilot plants, New Zealand, Organic matter, Biochemical oxygen demand, Chemical oxygen demand, Color, Carbohydrates, Lignin degradation products, Toxicity, Biodegradation.

Stillage, the wastewater produced by the New Zealand Forest Research Institute pilot scale wood-ethanol process, was characterized to determine its suitability for treatment by anaerobic digestion. Major characteristics are: volume, 20.4 l/kg oven-dry wood; chemical oxygen demand, 25.5 g/l; biochemical oxygen demand (5-day), 13.2 g/l; and color, 4200 chloroplatinate units. It is a relatively strong, highly colored, soluble wastewater. The organic matter is composed mainly of unfermented pentose sugars, and carbohydrate and lignin degradation products. Based on the toxicity and biodegradability of these compounds, the stillage should be amenable to anaerobic digestion. (See also W87-05960) (Author's abstract)
W87-05954

SPECIATION OF HEAVY METALS IN THE SLUDGE OF AN OXIDATION POND (SPECIATION DES METAUX LOURDS PRESENTS DANS LES BOUES D'UN BASSIN DE LAGUNAGE NATUREL),
Ecole Nationale de la Sante Publique, Rennes (France). Lab. de Genie Sanitaire.
J. Carre, and B. Welte.
Environmental Technology Letters ETLEDB, Vol. 7, No. 6, p 351-362, June 1986. 2 fig, 2 tab, 24 ref.

Descriptors: *Path of pollutants, *Wastewater treatment, *Oxidation ponds, *Sludge, *Heavy metals, *Speciation, Chemical reactions, Oxides, Accumulation.

The speciation of heavy metals (Cd, Cr, Cu, Ni, Pb, Zn, Co, Fe, Mn) in the sludge of an oxidation pond was determined. The effect of sludge maturation on the partition of metals was studied. After 10 yr of storage, if concentrations of Fe, Mn, Ni, and Co are preserved, concentrations of Cd, Cu, Pb, Zn, and Cr associated with organic but easily reducible oxide and oxyhydrate phases have decreased. (Author's abstract)
W87-05956

PERFORMANCE OF AN ANAEROBIC REACTOR UNDER EXTREME LOADS,
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
J. A. Oleszkiewicz, and S. Koziarski.
Environmental Technology Letters ETLEDB, Vol. 7, No. 7, p 373-382, July 1986. 5 fig, 2 tab, 4 ref. Marie Sklodowska-Curie Joint Fund Project JB 5-534-7.

Descriptors: *Chemical oxygen demand, *Organic loading, *Anaerobic Treatment, *Sludge, *Wastewater treatment, *Performance evaluation, Efficiency.

Suspended growth anaerobic reactors consisting of two consecutive zones, downflow completely mixed and plug upflow sludge blanket zone, were loaded with organics form 2-110 kg chemical oxygen demand (COD)/cu m/day. Despite a high solids content in the raw wastes (total soluble to COD ratio 1.9), the reactors performed without upsets under all loads. COD conversion to gas dropped from 0.22 cu m/kg COD removed to 0.072 cu m/kg for the highest loaded reactor. The COD removal efficiency at the highest load was 35%, which corresponded to 39.5 kg COD removed/cu m daily. (Author's abstract)
W87-05958

EXAMINATION OF ANAEROBIC UPFLOW FILTERS OPERATED IN A CASCADE SEQUENCE,
Birmingham Univ. (England). Dept. of Civil Engineering.
M. Y. Cheung, D. L. Oakley, and C. F. Forster.
Environmental Technology Letters ETLEDB, Vol. 7, No. 7, p 383-390, July 1986. 8 fig, 11 ref. Science and Engineering Research Council (England) Grant GR/C/35561.

Descriptors: *Anaerobic treatment, *Pollution loading, *Chemical oxygen demand, *Wastewater treatment, Biofilms, Electron microscopy, Methanogenic bacteria, Performance evaluation, Cascade sequence.

A sequence of three anaerobic filters was operated as a cascade process at organic loading rates up to 13.5 kg chemical oxygen demand (COD)/cu m/day. As the loading rate increased, the first and third filters operated increasingly as acidogenic and methanogenic reactors, respectively. An examination of the biofilm using scanning electron microscopy showed a dominance of methanogenic bacteria in the third filter. (Author's abstract)
W87-05959

ANAEROBIC DIGESTION OF STILLAGE FROM A PILOT SCALE WOOD-TO-ETHANOL PROCESS: II. LABORATORY-SCALE DIGESTION STUDIES,
New Zealand Forest Service, Rotorua. Forest Research Inst.
I. J. Callander, T. A. Clark, and P. N. McFarlane.
Environmental Technology Letters ETLEDB, Vol. 7, No. 7, p 397-412, July 1986. 8 fig, 6 tab, 29 ref.

Descriptors: *Wastewater treatment, *Anaerobic digestion, *Stillage, *Wood wastes, *Wood-ethanol process, Pilot plants, New Zealand, Organic matter, Chemical oxygen demand, Methanogenic bacteria, Pollution load.

Anaerobic digestion of stillage from a pilot-scale wood-to-ethanol process was investigated using an 8-l, continuously-fed reactor. A methanogenic consortium acclimated to Pinus radiata stillage was developed over 160 days by maintaining a low organic loading rate. The loading rate was then gradually increased to about 4 kg chemical oxygen demand (COD)/cu m/day. Nutrient, alkalinity, and mineral requirements were quantified. Approximately 90% COD removal was obtained at specific COD utilization rates up to 0.5 g COD/g volatile suspended solids (VSS) daily. The methane and true cell yields, per gram of soluble COD removed, were 0.313 l CH4 (standard temperature and pressure) and 0.142 g VSS. The endogenous decay coefficient was 0.0083/day. (See also W87-05954) (Author's abstract)
W87-05960

ANAEROBIC DIGESTION OF WOOL SCOURING WASTEWATER IN A DIGESTER OPERATED SEMI-CONTINUOUSLY FOR BIOMASS RETENTION,
Sydney Univ. (Australia). Dept. of Chemical Engineering.
R. G. Cail, J. P. Barford, and R. Lichacz.
Agricultural Wastes AGWADL, Vol. 18, No. 1, p 27-38, 1986. 4 fig, 2 tab, 13 ref.

Descriptors: *Anaerobic digestion, *Industrial wastes, *Organic wastes, *Wastewater treatment, *Wool scouring, Biomass, Effluents, Waste disposal, Enzymes.

The disposal of the high strength effluents produced by the wool scouring and carbonising industry represents a problem of considerable magnitude worldwide. While it is generally accepted that aerobic or anaerobic lagoons, followed by irrigation, offer the most cost effective solution, not all industries are fortunate enough to have adquate areas of land, or are in a favorable location to install such systems. The low energy requirement of anaerobic digesters, coupled with the fact that they produce methane which could be used in the mill for heating water, etc., gives them considerable advantages over other waste treatment systems. Recent developments in the design and operation of anaerobic digesters have resulted in significant improvements in the rate, process control and cost effectiveness of anaerobic treatment of effluents from agricultural and food-processing industries. The objective of this program was to investigate the feasibility of a semi-continuous digester system for the treatment of wool-scouring effluent. An anaerobic digester, operated semi-continuously in order to retain high concentrations of biomass in the digester, was used to treat wool scouring wastewater. At a space load of 9.9 kg COD /cu m/day (hydraulic retention time, 2.8 days) greater than 56 percent of the COD and 47 percent of the grease were removed. At these efficiencies, this rate was estimated to be at least 2.5-3.0 times greater than that which would be achieved in a continuously stirred digester. Preliminary studies of enzymatic pretreatment of the scouring effluent showed that significantly improved treatment rates and/or efficiencies could be achieved, that is, greater than 70 percent removal of both the COD and grease at a space load of 12 kg COD/cu m/day. It is unlikely that any substantial levels of flocculation would develop in this system and it is expected that the moderate use of polyelectrolytes would be required to help maintain the VSS concentration in the reactor. (Authors' abstract)
W87-05976

OPERATION OF A LABORATORY-SCALE TUBULAR DIGESTER ON PIGGERY WASTE,
Polytechnic of Wales, Pontypridd. Dept. of Science.
J. R. S. Floyd, and F. R. Hawkes.
Agricultural Wastes AGWADL, Vol. 18, No. 1, p 39-60, 1986. 6 fig, 4 tab, 18 ref.

Descriptors: *Wastewater treatment, *Digestion, *Anaerobic digestion, *Animal wastes, Performance evaluation, Hogs.

Plug-flow digesters are elongated reactors along which waste moves by a process of displacement as it is digested. They are unstirred, thus requiring no moving parts or energy input for mixing, and

may be constructed cheaply by excavating and lining a trough in the ground and enclosing it with a flexible polymer sheeting that acts as a gas storage chamber. Such digesters are produced commercially and appear to operate successfully apart from severe scumming that leads, at times, to blockages. Scumming occurs where particulate solids can accumulate at a gas/liquid interface, and such an interface can be minimized if the digester is inclined. Such a reactor is referred to as a tubular digester. Inclined tubular digesters retain solids when operated on low strength particulate wastes and thus give greater gas yields per Volatile Solids added than conventional stirred-tank reactors. The performance of laboratory-scale inclined tubular digesters over a range of operating conditions in the mesophilic temperature range is reported here and compared with those found for conventional stirred digesters. Three inclined tubular digesters of 13- and 15-liter volume were operated at temperatures between 20 and 30 C with hydraulic retention times of 10-50 days on pig slurry of 10, 5, and 2.5 percent total solids content. Tube inclination of 16-20 degrees gave no scumming problems. Solids were retained, giving improved gas yields when compared with literature values for conventional stirred digesters. Solids retention is affected by the size of the digester exit and appears to be greater with slurry of low solids content. There is a link between the movement of solids and gas along, and out of, the digester which can lead to unstable oscillating gas production. Tracer studies showed soluble components of the slurry mixed throughout the whole volume of the digester in 25 percent of the digestion time or less. Solids moved in well dispersed plug flow. Gas production (both intrinsic and after the addition of acetate) was most rapid in the central section of the digester. Extracellular carboxy-methyl cellulose activity was not uniform throughout the digester, suggesting that activity was particle associated. (Authors' abstract)
W87-05977

STUDIES ON SYNTHESIS OF ION-EXCHANGE MEMBRANE FOR ELECTRODIALYTIC TREATMENT OF BLEACHING PLANT EFFLUENT,
Indian Inst. of Tech., Bombay. Dept. of Chemical Engineering.
B. Chakravorty, R. N. Mukherjee, and S. Basu.
International Journal of Environmental Studies IJEVAW, Vol. 27, No. 3/4, p 173-181, 1986. 4 fig, 3 tab, 19 ref.

Descriptors: *Wastewater treatment, *Ion exchange, *Electrodialysis, *Membranes, *Bleaching wastes, *Membrane processes, Pulp and paper industry, Industrial wastewater, Polymers.

An attempt was made to synthesize ion-exchange membranes based on chemical grafting of styrene on poly-ethylene film with benzoyl peroxide as initiator and di-vinyl benzene as the cross-linking agent, under optimum processing conditions obtained during experimental work. Electro-chemical properties of the membrane were evaluated and utilized in designing a multi-compartment electrodialysis cell, for electrodialytic treatment of bleach plant effluent from the pulp and paper industry. Electrodialysis studies under optimum conditions of 20 mA/sq cm current density indicate the technical feasibility of developing a process for abatement of pollution, along with recycling of water, from multi-stage bleaching stage effluent. (Authors' abstract)
W87-05985

LOW COST SANITATION ALTERNATIVES OF WASTEWATER TREATMENT FOR DEVELOPED AND DEVELOPING COUNTRIES,
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
S. V. R. Rao.
International Journal of Environmental Studies IJEVAW, Vol. 27, No. 3/4, p 211-218, 1986. 2 fig, 19 ref.

Descriptors: *Sanitation, *Sanitary wastewater, *Developing countries, *Wastewater treatment, *Sewer systems, Septic tanks, Lagoons.

A recent, major development is the realisation in some developing countries of the importance of low cost sanitation systems as opposed to conventional sewage disposal systems. Several low cost sanitation alternatives applicable to both developed and developing countries are discussed. Conventional sewage systems are culturally and economically unsuitable for many of the developing countries. There sanitation could be greatly improved by adapting low cost sewage treatment technologies intermediate between pit privies and conventional sewage systems. Other low cost wastewater treatment alternatives such as oxidation ponds, aerated lagoons, and anaerobic lagoons are discussed with regard to their scope of application in the developing countries. On-site sanitation alternatives, such as septic tanks, are feasible in developed countries. On-site sanitation alternatives for sewage disposal are becoming quite popular in the U.S. However, sufficient care must be exercised with regard to on-site disposal systems on problem soils to alleviate any possible contamination threat to the groundwaters. Sand envelopes have been reported to be suitable to the situation of the developing countries to prevent transport of bacteria and other waterborne pathogens. (Author's abstract)
W87-05986

REVIEW OF THE TECHNOLOGICAL FEASIBILITY OF AQUACULTURES FOR MUNICIPAL WASTEWATER TREATMENT,
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
S. V. R. Rao.
International Journal of Environmental Studies IJEVAW, Vol. 27, No. 3/4, p 219-223, 1986. 10 ref.

Descriptors: *Reviews, *Municipal wastewater, *Wastewater treatment, *Aquaculture, Water hyacinth, Duckweed, Phosphorus, Nitrogen.

Recent years have seen a rapid advance in aquaculture technology for treatment of municipal wastewater. The technical feasibility of utilising aquacultures for such purposes is reviewed. Aquaculture containing one or more aquatic weeds are cost effective for secondary and tertiary wastewater treatment, compared to the highly energy intensive conventional secondary and tertiary wastewater treatment systems. The major advantages are less capital and maintenance costs required as opposed to conventional wastewater treatment. Aquatic treatment systems utilising one or two aquatic weeds are efficient in substantial removal of phosphorus and nitrogen from the wastewater compared to the conventional secondary and tertiary wastewater treatment systems. Further, biogas generated from the harvested aquatic weed biomass could meet the treatment costs of the aquatic treatment systems utilizing these aquatic weeds. Year round treatment of municipal wastewater utilising these aquatic weeds is possible even in temperate regions of the world by housing the treatment systems in greenhouses. Other aquatic weeds which have tolerance to extreme cold conditions could be tested to make year round treatment of wastewater in aquatic treatment systems. (Author's abstract)
W87-05987

GROWTH OF DUCKWEED AND NUTRIENT REMOVAL IN A PADDY FIELD IRRIGATED WITH SEWAGE EFFLUENT,
Ehime Univ., Matsuyama (Japan). Dept. of Environment Conservation.
For primary bibliographic entry see Field 5E.
W87-05991

CHEMICAL EXERGY OF ORGANIC MATTER IN WASTEWATER,
National Inst. for Environmental Studies, Tsukuba (Japan).
S. Tai, K. Matsushige, and T. Goda.
International Journal of Environmental Studies IJEVAW, Vol. 27, No. 3/4, p 301-315, 1986. 5 fig, 3 tab, 7 ref.

Descriptors: *Wastewater treatment, *Exergy, *Organic matter, *Chemical oxygen demand, *Total oxygen demand, *Total organic carbon, Thermodynamics.

The chemical exergy of organic matter in wastewater to is related to the comprehensive indices COD, TOD, and TOC. A new thermodynamic function named exergy is useful for the thermodynamic analysis of wastewater processes based on the second law of thermodynamics. It is shown that the standard chemical energy of an organic compound is calculated with the aid of the standard free energy of formation. It is further demonstrated that the relation between the standard chemical exergies and the theoretical values of TOD or TOC of 138 organic compounds are shown in the following equations: standard chemical energy (J/1)=13.6 x TOD (mg/l), or 45.0 x TOC (mg/l). The correlation coefficient is high. Measured values of TOD and TOC of most organic compounds are 95 to 100 percent of the theoretical values, and the chemical exergy of organic matter in samples from various sources is given quite well using these equations. The standard free energy of formation, exergy, TOC and TOD are given for 138 organic compounds. The standard chemical exergy for a substance can be used for the evaluation of the energy budget of a wastewater system, and for determining the most energy efficient system among various chemical and biological wastewater treatment processes. (Authors' abstract)
W87-05993

POTENTIAL FOR EXPERT SYSTEMS IN THE OPERATION AND CONTROL OF ACTIVATED SLUDGE PLANTS,
Leeds Univ. (England). Dept. of Civil Engineering.
N. J. Horan, and C. R. Eccles.
Process Biochemistry PRBCAP, Vol. 21, No. 3, p 81-85, June 1986. 3 fig, 2 tab, 17 ref.

Descriptors: *Expert systems, *Activated sludge process, *Process control, *Maintenance, *Automation, *Wastewater facilities, *Wastewater treatment, Biological wastewater treatment, Computers, Microscopic analysis, Water analysis, Bacteria, Protozoa, Research priorities, Engineering.

Current methods of activated sludge trouble-shooting rely heavily on the application of rule of thumb techniques (heuristics) whose success depend upon operator experience. Typical problems encountered during the everyday running of an activated sludge plant are described together with the remedial actions available to plant operators. A quick and reliable method of trouble-shooting is proposed which involves the microscopic examination of reactor mixed liquors to yield a profile of filamentous bacteria and protozoan species present. This profile can then be compared with species that have been found associated with specific problem conditions. It is further proposed that this approach can be readily adapted for use with an expert system which draws both upon operator experience and the findings of many research workers regarding the potential of 'problem indicator organisms.' A basic description of the construction of an expert system is provided along with suggestions on how such a system might be implemented. Requirements for future research to provide the information necessary to achieve this aim are highlighted. (Author's abstract)
W87-05999

KINETICS OF PIGGERY WASTES TREATMENT IN ANAEROBIC LAGOONS,
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
J. A. Oleszkiewicz, and S. Koziarski.
Agricultural Wastes AGWADL, Vol. 16, No. 1, p 13-25, 1986. 5 fig, 2 tab, 7 ref. EPA Agreement Project JB-5-534-7.

Descriptors: *Wastewater treatment, *Animal wastes, *Farm wastes, *Kinetics, *Anaerobic lagoons, *Anaerobic digestion, Wastes, Lagoons, Performance evaluation, Design criteria, Sedimentation, Biological treatment.

Results of laboratory studies of anaerobic lagoon performance were analyzed to yield kinetic data applicable for design. None of the models currently used fitted the data. A novel interpretation was proposed based on the dependence of effluent quality on volumetric organic loading. It is suggested that removal takes place in consecutive stages at a progressively decreasing rate, expressed in kg/cu m/day. In the case of dilute piggery wastes from large farms, the first stage of rapid sedimentation takes only a few hours and achieves some 55% removal of COD. The second stage, biochemical removal, proceeds at 1.7 kg COD/cu m/day for about three days HRT, and then the removal rate drops down to 0.2 kg COD/cu m/day. (Author's abstract)
W87-06001

MEMBRANE-BASED HYBRID PROCESSES FOR ENERGY-EFFICIENT WASTE-WATER TREATMENT,
Bend Research, Inc., OR.
R. J. Ray, J. Kucera-Gienger, and S. Retzlaff.
Journal of Membrane Science JMESDO, Vol. 28, No. 1, p 87-106, August 1986. 20 fig, 3 tab, 18 ref.

Descriptors: *Membranes, *Membrane processes, *Reverse osmosis, *Wastewater treatment, *Distillation, Performance evaluation, Optimization, Technology, Economic aspects, Costs, Capital costs, Maintenance costs, Operating costs.

Membrane-based hybrid processes combine conventional unit operation (e.g., distillation or solvent extraction) with a membrane-separation process (e.g., reverse osmosis). Two membrane-based hybrid applications are discussed: the processing of corn steep water, and the recycling of space station wash waters. The processes use a novel, fouling-resistant reverse osmosis membrane module being developed at Bend Research. The corn steep water treatment process was optimized using operating costs as the optimization variable. The space-station wash water recycle system was optimized for minimum launch and resupply penalties and for minimum power requirements. The two systems studied suggest that membrane-based hybrid processes do offer significant advantages for some separations. It is concluded that each situation must be studied not only for the technical constraints, but for the appropriate economic and institutional constraints as well. (Author's abstract)
W87-06013

GENES POUND TO HELP BACTERIA 'EAT' PESTICIDES,
Science and Education Administration, Beltsville, MD. Pesticide Degradation Lab.
D. Akaler.
Agricultural Research AGREA5, Vol. 34, No. 8, p 14, September 1986.

Descriptors: *Genetic engineering, *Bacteria, *Pesticides, *Enzymes, *Waste treatment, *Biological treatment, *Waste disposal, *Biodegradation, *Soil bacteria, Achromobacter, Farm wastes, Carbofuran, Flavobacterium, Carbamate pesticides, Insecticides, Degradation, Enzymes.

Two soil bacteria have been found that can be genetically altered to accelerate the breakdown of pesticides. One is an Achromobacter that fully degrades carbofuran in a matter of hours. The other is a Flavobacterium that partially degrades coumaphos in about 36 hours, although complete degradation requires another day of treatment with ultraviolet light and ozone. Research on these bacteria is being conducted by microbiologist Jeffrey S. Karns and his colleagues at the federal Agricultural Research Service in Beltsville, MD. (Doria-PTT)
W87-06018

AEROBIC TREATMENT OF WINE-DISTILLERY WASTEWATERS,
Cadiz Univ. (Spain). Faculty of Sciences.
D. Sales, M. J. Valcarcel, L. Perez, and E. Martinez de la Ossa.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 1, p 9-14, January 1987. 5 tab, 10 ref.

Descriptors: *Aerobic treatment, *Biological treatment, *Food-processing wastes, *Aerobic digestion, *Wastewater treatment, *Performance evaluation, Water quality, Industrial wastes, Digestion, Activated sludge process, Oxygen demand, Biological oxygen demand, Chemical oxygen demand, Suspended solids, Nutrients, Nitrogen, Phosphorus, Oxygen, Dissolved oxygen.

The start-up of digestors for aerobic treatment of vinasses (wine distillery waste) was studied, along with the establishment of optimum operating conditions for an adequate depurative process. The activated sludge technique was used, involving completely mixed aerobic digestors without sludge recycle. Digestors were maintained at the optimum temperature of 25 degrees C. Air flow was 5 l/min per digestor. It was found that pH stabilized at about 8 in each digestor, irrespective of the type of vinasse treated. COD and BOD fell with time; their removals were stabilized at 70% and 75%, respectively, reaching 80% and 85% in centrifuged effluents. Total organic and solids contents stabilized at 40-47%, and suspended solids stabilized at 5-6 g/l after the first week; of these solids, 90% are organic, making up the digestor biomass. Nitrogen was not eliminated from the medium. Neutralization of vinasses does not improve depurative performance, which simplifies the process and reduces operating cost. Optimum retention time is eight days. (Doria-PTT)
W87-06022

PROTECTION OF GROUNDWATER BY IMMOBILIZATION OF HEAVY METALS IN INDUSTRIAL WASTE IMPACTED SOIL SYSTEMS,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 5E.
W87-06079

INCORPORATING A RULE-BASED MODEL OF JUDGEMENT INTO A WASTEWATER TREATMENT PLANT DESIGN OPTIMIZATION MODEL,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
J. J. Geselbracht, E. D. Brill, and J. T. Pfeffer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB87 131751/AS, Price codes: A04 in paper copy, A01 in microfiche. Illinois Water Resources Center, Urbana-Champaign, UILU-WRC-86-199, WRC Research Report No. 199, April 1986. 68 p, 11 fig, 16 tab, 49 ref. Project No. S-092-ILL.

Descriptors: *Wastewater Treatment, *Wastewater treatment plants, *Optimization, Model studies, Mathematical, Rule-based models, Cost effectiveness, Wastewater.

The use of a rule-based modeling technique for the formal consideration of poorly modeled issues in a water quality management problem is illustrated in the context of wastewater treatment plant design. Sludge bulking is a poorly understood problem in activated sludge wastewater treatment plants. An engineer must use judgement gained from experience when he designs an activated sludge plant to prevent bulking from causing the plant to fail. An attempt was made to use fuzzy logic in order to model that judgement. Results from research were taken from the literature and used independently as constraints to an activated sludge wastewater plant design optimization model to see their effect on the optimal design. Some of the research results were then formulated as rules in a rule-based system which relates design variable values to the likelihood of a design experiencing bulking problems. The weights of association of those rules to the conclusion that a given design would experience bulking problems and the logical interaction of those rules were calibrated using an experienced engineer's evaluation of a set of 15 plant designs. The consistency of the engineer's and the judgement model's evaluations were then checked with a second set of 15 designs. The model of judgement could be used to evaluate the bulking potential of any design. In the particular example developed, the judgement model was incorporated into a wastewater treatment plant design optimization model so that the cost-effectiveness of constraint combinations could be examined. The tradeoff between cost and the likelihood of experiencing bulking problems was examined for a typical plant design problem. (Stout-IL WRC)
W87-06097

ROTATING BIOLOGICAL CONTACTOR APPLICATION TO HAWAII,
Hawaii Univ., Honolulu. Dept. of Public Health Sciences.
M. J. Chun, R. H. F. Young, and G. T. Griffith.
IN: Collected Reprints, Volume V: 1978-1981, June 1984. Water Resources Research Center, Honolulu, Hawaii. p 40-45.

Descriptors: *Biological wastewater treatment, *Biological filters, *Cost analysis, *Activated sludge process, Pilot plants, Biological oxygen demand, Hawaii, Suspended solids, Comparison studies, Wastewater treatment.

A rotating biological contactor (RBC) field test unit was operated at the City and County of Honolulu's Pacific Palisades Wastewater Treatment Plant located in Pearl City. The RBC was designed for a hydraulic flow of 1000 gpd, and consisted of a primary clarifier, a 4-stage rotating disc component, a final clarifier, and a sludge storage basin. Results showed that the RBC produced an effluent quality compatible with domestic wastewater treatment needs in suburban areas in Hawaii. The RBC process required little operational control and maintenance. These features coupled with low energy requirements make the RBC process economically competitive with packaged activated sludge units. At a hydraulic loading of 6.5 gpd/sq ft, the RBC process achieves overall carbonaceous BOD and suspended solids removals of 85%. At this loading, 25% N removal and 10% P removal can be expected. With the RBC process, sludge production can be estimated on the basis of 0.5 mass units sludge produced/mass unit BOD removed. (See also W87-06103) (Geiger-PTT)
W87-06105

MECHANISMS OF POLIOVIRUS INACTIVATION BY HYPOCHLOROUS ACID,
Hawaii Univ., Honolulu. Dept. of Microbiology.
K. M. Tenno, R. S. Fujioka, and P. C. Loh.
IN: Collected Reprints, Volume V: 1978-1981, June 1984. Water Resources Research Center, Honolulu, Hawaii. p 243-248, 5 fig, 1 tab, 8 ref.

Descriptors: *Viruses, *Chlorination, *Disinfection, *Enteroviruses, *Microbiological studies, Water treatment, Fate of pollutants, Chlorine, Pathogens, Proteins, Nucleic acids, Wastewater treatment, Infection, Chemical treatment.

The mechanism of virus-inactivation by hypochlorus acid was studied in radioactively labeled attenuated strains of type 1 poliovirus. After 30 min reaction with HOCl, nearly the same amount of infectious viral RNA could be recovered from the chlorine-treated virus as from the untreated virus preparation, indicating that the viral RNA was not affected by chlorination. In addition, after inactivation of nearly 99.999% of the virus, over 50% of the virus particles still retained their normal rate of sedimentation and buoyant density. These findings suggest that HOCl inactivates poliovirus by reacting with the protein component of the virus and that the inactivating reaction does not result in any detectable change in the structure of the virus. The infectivity of the viral RNA was not affected by HOCl. Degradation of the protein structure of the virus occurs only after prolonged contact and presumably multiple reactions of HOCl with the protein coat. (See also W87-06103) (Geiger-PTT)
W87-06118

PROBLEMS AND RESEARCH NEEDS WITH SAFE REUSE OF WATER,
Illinois Univ. at Urbana-Champaign. Inst. for Environmental Studies.

For primary bibliographic entry see Field 3C.
W87-06154

PROCESS TRAIN EVALUATION FOR TREATMENT OF TAR SANDS WASTEWATERS,
Arizona Univ., Tucson. Dept. of Civil Engineering and Engineering Mechanics.
R. A. Sierka.
Available from NTIS, Springfield, Virginia, 22161 as DE84 012013, A06 in paper copy, A01 in microfiche. Dept of Energy, Office of Fossil Energy, Laramis, WY, DOE/LC/10773-1639, March 31, 1983. Final Report. DOE Contract No. DE-AS20-81LC10773. 103 p, 22 fig, 30 tab, 46 ref, 4 append.

Descriptors: *Wastewater treatment, *Tar sands, *Activated carbon, *Ozonation, *Reverse osmosis, Filtration, Foam, Fractionation, Chemical treatment, Total organic carbon, Ozone, Membrane filters.

Activated carbon, ozone and reverse osmosis was evaluated for treating two tar sand wastewaters generated by steam flooding (1S) and reverse combustion (2C) procedures. Substrates for these studies included untreated and pretreated (filtration, foam fractionation, chemical treatment with ferric chloride) 1S and 2C wastewaters. Activated carbon, at a dose of 1,000 mg/L, reduced the TOC of 1S wastewater after treatment by 350 mg/L of ferric chloride to 2.262 mg/L TOC, a reduction of 91.64%. At the same adsorbent dose, activated carbon reduced the TOC in 2C wastewater from 678.0 mg/L to 548.8 mg/L by 19%. A study of the six commercially available adsorbents yielded little difference in adsorption for either wastewater. Ozonation of 1S wastewater after pretreatment by either foam fractionation or chemical treatment with ferric chloride then activated carbon yielded TOC levels of less than 1.2 mg/L. The use of ozone on 2C wastewater was not effective. Only 8.7% of the total TOC had been removed after 1.0 hour of ozonation at a rate of 56.9 mg/L/hr. Reverse osmosis studies included investigation of four membrane types (cellulose acetate, poly-ether amide, poly-ether urea and noncellulosic on a polysulfane base), three applied pressure levels (250, 400 and 5550 psig) and two solution pH levels (5.5 and 7.8) with 5.0 micrometers filtered 2C wastewater as the substrate. Organic rejections as measured by TOC ranged from 67.1% to 98.1% while inorganic rejections as conductivity, ranged from 80.0% to 98.7%. Permeate flux rates increased with system pressure for each membrane from 3.3 GFD to 47.3 GFD. (Lantz-PTT)
W87-06198

MODELLING OF SEDIMENTATION,
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
A. James.
IN: An Introduction to Water Quality Modelling, John Wiley and Sons, Chichester, England. 1984. p 169-181, 5 fig, 1 tab, 2 ref, 2 append.

Descriptors: *Model studies, *Sedimentation, *Wastewater treatment, Suspended particles, Flocculation, Mathematical models, Settling tanks, Computer programs, Computer models, Computers.

The physical process of removing suspended matter from wastewater by sedimentation has formed an essential part of treatment for many years. However, in spite of its long history, the prediction of the performance of sedimentation tanks has proved difficult especially when treating heterogeneous suspensions. Two factors are mainly responsible for the variation in the way in which particles settle out of suspension: (a) the concentration of the suspension; and (b) the flocculating properties of the particles. Settlement can be broadly classified into four main categories: class 1, class 2, zone settling, and zone compression. Modeling of zone settling, secondary sedimentation tanks, and computer-aided design of sedimentation tanks are presented. (See also W87-06216) (Lantz-PTT)
W87-06226

ACTIVATED SLUDGE MODELS,
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
A. James, and D. J. Elliott.
IN: An Introduction to Water Quality Modelling, John Wiley and Sons, Chichester, England. 1984. p 182-196, 6 fig, 6 ref, append.

Descriptors: *Wastewater treatment, *Activated sludge, *Model studies, Activated sludge process, Mathematical models, Mathematical studies.

The activated sludge process is one alternative frequently used for the removal of organic material in wastewater. In this process, a large population of microorganisms is maintained in suspension in a tank through which wastewater passes. Air or oxygen is supplied and purification takes place in a series of steps in which bacteria utilize the organic material to yield new cells and provide energy. Purification is achieved as a direct result of microorganism metabolism which depends on the presence of sufficient oxygen and the high contact rate between the activated sludge and the waste. The term 'activated' refers to the ability of the sludge floc to quickly absorb colloidal and suspended material from solution. Initial removal of organics is due almost entirely to adsorbtion. Synthesis is proportional to biological oxidation and acts at a slower rate than the adsorptive process. Hence, organics initially adsorbed but not immediately synthesized are stored in the activated sludge floc. When the full capacity of the sludge has been utilized it becomes inactive in the adsorptive sense and activity can only be restored by a period of aeration during which stored material is used in oxidation and synthesis. Process design and operation, model structure, and modifications to the model are presented. (See also W87-06216) (Lantz-PTT)
W87-06227

MODELLING OF FIXED FILM REACTORS,
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
A. James.
IN: An Introduction to Water Quality Modelling, John Wiley and Sons, Chichester, England. 1984. p 197-209, 4 fig, 4 ref, append.

Descriptors: *Wastewater treatment, *Fixed film reactors, *Model studies, Biological wastewater treatment, Contact beds, Contact filters, Percolating filters, Mathematical models, Mathematical studies.

Fixed-film reactors have been used extensively for over 100 years in the treatment of wastewaters with the development of contact beds and percolating filters from land treatment. More recently, the development of plastic packing materials has extended the scope of fixed-film reactors and has led to high rate filters. Although the two types (percolating filters and high rate filters) are both fixed-film reactors, there are sufficient fundamental differences to make these distinct processes. The obvious differences are the much higher hydraulic and organic loading rates used in high rate filters and the much greater use of recirculation. Also the use of plstic media with larger surace area and higher percentage voids. Less obvious but equally fundamental, are the biological difference caused by these environmental changes. The mechanism for controlling the film growth in high rate filters is hydraulic rather than biological: higher void ratios and thinner bacterial films make the flow regime independent of film thickness and organic transfer rates introduce the possibility of oxygen limitation. The theory of organic and oxygen transfer into fixed films and the consequent film growth is discussed, followed by a section dealing with the modeling of high rate filters and a final section dealing with percolating filters. (See also W87-06216) (Lantz-PTT)
W87-06228

MODELLING OF ANAEROBIC PROCESSES USED IN WASTEWATER TREATMENT,
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
A. James.
IN: An Introduction to Water Quality Modelling, John Wiley and Sons, Chichester, England. 1984. p 210-220, 7 fig, 1 tab, 5 ref, 2 append.

Descriptors: *Wastewater treatment, *Anaerobic digestion, *Model studies, Contact beds, Activated sludge process, Mathematical models, Mathematical studies, Hydraulics.

There are a variety of anaerobic processes used in treating wastewaters, mainly digestion, but also filters and contact digesters. In modeling these processes, the hydraulic situation needs to be considered first since all types of reactors from plug flow to completely mixed may be used. Once the hydraulics have been adequately described either from theoretical considerations or tracer studies, then attention can be concentrated on the microbiology and biochemistry. The approach to this is somewhat different to that used in aerobic processes. It is described in this chapter. (See also W87-06216) (Lantz-PTT)
W87-06229

MODELLING OF OVERALL TREATMENT,
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
A. James.
IN: An Introduction to Water Quality Modelling, John Wiley and Sons, Chichester, England. 1984. p 221-230, 7 fig, 3 ref.

Descriptors: *Wastewater treatment, *Model studies, *Mathematical models, Optimization, Secondary wastewater treatment, Tertiary wastewater treatment, Mathematical studies.

There are a number of attractions to models of overall treatment. On the design side they overcome the problem of interfacing units, so that changes in the performance of a primary unit are passed on to secondary and tertiary units enabling a wide range of possiblities to be explored. This enables optimization to be performed on the combined units so that the cheapest overall scheme can be chosen. On the operational side, they enable the simulation of shock loads or special operating conditions (e.g. primary clarifier out of action) to be carried out to determine the best operating procedure or the likely period of recovery. There are however, considerable difficulties in formulating such models, and such circumstances it seems desirable to use an interactive approach so that the user is able to explore a large nubmer of permutations but at the same time retains control over the possibilities being explored. A flow diagram for an interactive model is presented and shows how the design is produced as the result of calculations by the computer and decisions by the designer. To avoid overcomplicating, the process is shown as occurring on a 'once through' basis but in practice the designer may explore any number of combination of units, various sizes of units and various site layouts. These would normally be explored only as far as the calculation of cost drawings would only be prepared for the best design. (See also W87-06216) (Lantz-PTT)
W87-06230

REMOVAL OF METALS FROM WASTEWATER: NEUTRALIZATION AND PRECIPITATION.
Noyes Publications, Park Ridge, NJ. 1984. 232 p. Edited by George C. Cushnie, Jr.

Descriptors: *Wastewater treatment, *Neutralization, *Chemical precipitation, *Heavy metals, Standards, Wastewater management, Legal aspects, Cadmium, Chromium, Beryllium, Copper, Lead, Mercury, Nickel, Silver, Zinc, Thallium, Cost analysis, Sludge disposal.

This book is a manual of design and operating procedures for the removal of metals from industrial wastewaters by neutralization and precipitation. Also covered are methods for handling and disposal of residues from the treatment processes. Effluent limitations for point source discharges into waterways or publicly owned treatment works have placed particular emphasis on the control of toxic materials. Among the toxic materials

identified by the U.S. Environmental Protection Agency are the heavy metals including beryllium, cadmium, chromium, copper, lead, mercury, nickel, silver, thallium, and zinc. This manual is designed as a practical guide to the management of a wastewater treatment program for those involved with the removal of metals from wastewaters. The book contains reviews of legal requirements, wastewater management practices, fundamental process chemistry, engineering design concepts and procedures, cost estimation, the state of the art of control of precipitate properties, and methods used for sludge treatment and disposal. It is a comprehensive source of practical information for the plant manager or operator, the engineer or consultant seeking to prepare preliminary process designs and cost estimates or to evaluate proposed treatment systems. Numerous graphical illustrations and an appendix of sample problems are included to enhance the reader's understanding of the material presented. (Lantz-PTT)
W87-06232

PROGRESS ON THE DELAWARE RIVER CLEAN-UP PROGRAM,
Philadelphia Water Dept., PA.
For primary bibliographic entry see Field 5G.
W87-06271

CHEMICAL ENGINEERING TREATMENTS FOR CONTAMINATED GROUND WATER,
NUS Corp., Houston, TX.
For primary bibliographic entry see Field 5G.
W87-06292

ENHANCED COLOUR REMOVAL FROM SEWAGE EFFLUENTS USING CHEMICAL FLOCCULANTS,
Laporte Inorganics, Cheshire (England).
W. Hatton, and A. M. Simpson.
Environmental Technology Letters ETLEDB, Vol. 7, No. 8, p 413-424, August 1986. 6 tab, 17 ref.

Descriptors: *Color removal, *Flocculation, *Sewage, *Wastewater treatment, Sludge, Polyaluminum chloride, Ferric sulfate, Aluminum sulfate, Phosphate, Chemical oxygen demand, Suspended solids, Wastewater composition, Costs.

Aluminum and ferric sulfates, together with polyaluminum chloride, were tested by laboratory jar techniques for their ability to reduce color levels in sewage sludge during flocculation. Other important parameters, including phosphate, chemical oxygen demand, and suspended solids, also were monitored. Success with the laboratory scale project led to full-scale plant trials lasting 3 mo. Color was reduced, but volume of primary sludge increased by 24% and dry solids by 5%. Cost factors are discussed. (Rochester-PTT)
W87-06362

PERFORMANCE OF LABORATORY ANAEROBIC HYBRID REACTORS WITH VARYING DEPTHS OF MEDIA,
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
J. A. Oleszkiewicz, E. R. Hall, and J. Z. Oziemblo.
Environmental Technology Letters ETLEDB, Vol. 7, No. 8, p 445-452, August 1986. 8 fig, 2 tab, 10 ref,.

Descriptors: *Anaerobic digestion, *Sludge digestion, *Anhybrid reactors, *Wastewater treatment, Wastewater facilities, Wastewater composition, Biomass.

A parallel study of laboratory scale anhybrid reactors with total media volume/total reactor volume ratios of 0.50, 0.40, 0.25, and 0.05 was carried out under unsteady state start-up conditions. All reactors incorporated an identical sludge bed zone volume and were seeded initially with the same amount of digester sludge. They were operated with an average flowrate of 6 l/day, with periodic increases in influent concentration. After 111 days, the reactors with the smallest media/total volume ratios failed. Greater media/total volume ratios were more effective in promoting the retention of biomass in the sludge bed zone. (Author's abstract)
W87-06363

SURVIVAL OF ANTIBIOTIC-RESISTANT ESCHERICHIA COLI IN AN ACTIVATED SLUDGE PLANT,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
G. R. Finch, and D. W. Smith.
Environmental Technology Letters ETLEDB, Vol. 7, No. 9, p 487-494, September 1986. 6 tab, 38 ref. Alberta Environmental Research Trust Grant TO937.

Descriptors: *Wastewater treatment, *Antibiotic resistance, *Activated sludge, *Survival, *Escherichia coli, *Secondary treatment, Statistics, Wastewater facilities, Effluents, Bacteria.

Antibiotic-resistant Escherichia coli were monitored in the raw influent wastewater and effluent of a plug-flow activated sludge wastewater treatment plant. A statistically significant increase in the proportion of multiple antibiotic-resistant E. coli was observed in the effluent. This suggests that conventional secondary treatment selects for antibiotic-resistant E. coli. The implications of these findings are considered and control alternatives are discussed. (Author's abstract)
W87-06366

KINETIC-BASED DESIGN FOR THERMOPHILIC ANAEROBIC TREATMENT OF HIGH-STRENGTH AGROINDUSTRIAL WASTEWATER,
Standards and Industrial Research Inst. of Malaysia, Shah Alam.
B. G. Yeoh.
Environmental Technology Letters ETLEDB, Vol. 7, No. 10, p 509-518, October 1986. 6 fig, 4 tab, 15 ref.

Descriptors: *Wastewater treatment, *Model studies, *Design criteria, *Anaerobic treatment, *Process control, Monod kinetics, Palm oil mill effluent, Temperature, Thermophilic bacteria, Wastewater facilities, Mathematical models, Pilot plants, Performance evaluation.

Data obtained from a pilot plant study on thermophilic anaerobic contract digestion of palm oil mill effluent (POME) at a temperature range of 45-55 C were treated with Monod kinetics. Process parameters derived from the kinetic model were tested and found to be in substantial agreement with the performance of a commercial-scale reactor. The model could be used as a basis for the design and operation of thermophilic anaerobic bioreactors in POME treatment. (Author's abstract)
W87-06368

START-UP, OPERATING REQUIREMENTS AND GRANULE FORMATION DURING UPFLOW SLUDGE BED TREATMENT OF A STRONG FOOD PROCESSING EFFLUENT,
Commonwealth Scientific and Industrial Research Organization, North Ryde (Australia). Div. of Food Research.
A. G. Lane.
Environmental Technology Letters ETLEDB, Vol. 7, No. 11, p 555-564, November 1986. 7 fig, 3 tab, 12 ref.

Descriptors: *Effluents, *Food-processing wastes, *Upflow sludge bed, *Sludge digestion, *Wastewater treatment, Citrus fruits, Chemical oxygen demand, Nitrogen, Phosphorus, Process control, Press liquor, Livestock feed, Pollution load.

Digestions of a strong liquid waste (a press liquor resulting from production of livestock feed from citrus peels; 50-150 g chemical oxygen demand (COD)/l) initiated with granular sludge were stable at a loading rate of 18 g COD/l/day using a high recycle rate. Specific rates of removal of lactic acid and ethanol were measured. Granules consisted of regions with different dominant populations of microorganisms. Granular sludge did not develop from municipal digester sludge, but stable digestion was maintained (6.5-9.0 g COD/l/day) by recycling treated liquid to dilute the incoming feed stream. Addition of N was not necessary, but addition of P was required. (Author's abstract)
W87-06371

IDENTIFICATION OF CHLORINATED COMPOUNDS IN THE SPENT CHLORINATION LIQUOR FROM DIFFERENTLY TREATED SULPHITE PULPS WITH SPECIAL EMPHASIS ON MUTAGENIC COMPOUNDS,
Senter for Industriforskning, Oslo (Norway).
For primary bibliographic entry see Field 5A.
W87-06394

RECOVERY, RECYCLE AND REUSE OF INDUSTRIAL WASTES,
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
K. E. Noll, C. N. Haas, C. Schmidt, and P. Kodukula.
Industrial Waste Management Series, Edited by James W. Patterson. Lewis Publishers, Inc., Chelsea, Michigan. 1985. 196 p, 3 fig, 26 tab, 373 ref.

Descriptors: *Waste management, *Industrial wastes, *Waste recovery, *Water reuse, Recycling, Economic aspects.

This book is directed to an audience including industrial and environmental engineers, and managers. It is designed to explain the underlying concepts, advantages and, in certain instances, disadvantages of recovery, recycle and reuse; to provide examples of existing applications of recovery technologies; and to identify and evaluate applications of a broad spectrum of existing and potential recovery technologies. Of particular value for the technologist is the organizational format of the technologies discussed, as well as the information on potential applications and, where they exist, current technical limitations on those applications. Managers can benefit from the non-technical overviews provided, plus the discussions of economic implications of recovery, recycle and reuse. (Lantz-PTT)
W87-06445

ANALYTICAL ASPECTS OF OZONE TREATMENT OF WATER AND WASTEWATER.
Lewis Publishers, Inc., Chelsea, Michigan. 1986. 413 p. Edited by Rip G. Rice, L. Joseph Bollyky, and William J. Lacy.

Descriptors: *Wastewater treatment, *Water treatment, *Ozone, Ozonation, Chemical analysis, Monitoring, Measuring instruments, Automation.

With the ever increasing interest in the application of ozone for water and wastewater treatment, several major questions arise in the minds of those new to this field: (1) What is the nature of ozone; (2) How is ozone applied in water and wastewater treatment; (3) How is ozone analyzed in its various applications; (4) How are the generation of ozone and ozonation reactions controlled analytically; and (5) How are ozonation processes automated. Because ozone is a gas at normal temperatures and pressures, because it is only partially soluble in aqueous media, and because it decomposes in aqueous media at significant rates, analyses for ozone and control of ozone generation and ozonation reactions are unique to this advancing technology. The editors of this book have attempted to answer these questions by assembling selected published treatises pertinent to the subject matter. Most of the reference works included in this book have appeared in publications of the International Ozone Association. Others appear with permission of the original publishers. Still others were written especially for this book. The book contains five major sections: (1) Fundamental parameters of ozone technology, (2) Analysis of ozone in aqueous solution, (3) Analysis of ozone in the gaseous phase, (4) Instrumental methods of analysis and monitoring of ozone, and (5) Automated procedures for controlling ozonation processes. (See also W87-06493 thru W87-06517) (Lantz-PTT)
W87-06492

APPLICATIONS OF OZONE IN WATER AND WASTEWATER TREATMENT,
Rice International Consulting Enterprises, Aston, MD.
R. G. Rice.
IN: Analytical Aspects of Ozone Treatment of Water and Wastewater, Lewis Publishers, Chelsea, Michigan. 1986. p 7-26, 3 fig, 2 tab, 42 ref.

Descriptors: *Ozone, *Water treatment, *Wastewater treatment, *Ozonation, Drinking water, Municipal wastewater, Industrial wastewater, Oxidation, Viruses, Chemical treatment, Biological treatment.

Various applications for ozone in treating drinking water and industrial and municipal wastewaters are described. It is important to understand specific aspects of the properties of ozone, and how and where ozone is applied in the various treatment process steps, because these factors affect the selection of appropriate analytical methodologies for determining concentrations of ozone or other parameters by which the ozonation processes can be controlled. Ozone is the most powerful oxidizing agent/disinfectant readily available for water and wastewater treatment. As a result, it is applied for the following purposes: disinfection and viral inactivation, chemical oxidation, and preoxidation in preparation for biological treatment. The amounts of ozone necessary to perform each of these functions depends upon a number of factors, but primarily upon the ozone demand of the constituents of the water/wastewater to be ozonized. During preozonation to prepare solutions for subsequent biological treatment, only small amounts of ozone are added (1 mg/L of ozone per mg/L of dissolved organic carbon). When used to oxidize pollutants which are rapidly reactive with ozone, attainment of a measureable ozone concentration can be taken as satisfaction of the ozone demand. Concentrations of residual ozone can be attained and monitored during disinfection and/or viral inactivation of waters which have little extraneous ozone demand (drinking water, swimming pool water, cooling water, etc.). For other drinking water or industrial water treatment applications, and for most wastewater applications, control of ozonation processes must be monitored by a surrogate analytical technique. Such process controls are not based upon monitoring of dissolved residual ozone. (See also W87-06492) (Lantz-PTT)
W87-06493

REQUIREMENTS FOR ANALYTICAL PROCEDURES AND METHODOLOGIES IN THE OZONE TREATMENT OF WATERS AND WASTEWATERS,
Rice International Consulting Enterprises, Aston, MD.
R. G. Rice.
IN: Analytical Aspects of Ozone Treatment of Water and Wastewater, Lewis Publishers, Chelsea, Michigan. 1986. p 27-39, 5 fig, 8 ref.

Descriptors: *Chemical analysis, *Monitoring, *Ozonation, *Water treatment, *Wastewater treatment, Water quality control, Ozone, Contact beds, Chemical treatment.

Analytical procedures are required to determine ozone in: (a) ozone generator exit gases (to monitor generator performance), (b) contactor inlet gases (to monitor applied ozone), (c) contactor exhaust gases (to determine ozone utilized; to size ozone destruct unit; to apply waste ozone to a second ozonation step), (d) contactor outlet water (for drinking water disinfection). Ozone concentration ranges are different in each case. In generator outlet gases and contactor inlet gases, concentrations up to 24 mg/cu m are experienced. Contactor exhaust gases contain ozone concentrations up to 3 to 4 mg/cu m. Contactor exit waters contain up to 0.5 mg/L of ozone. Disinfection of drinking water is controlled by monitoring a dissolved ozone residual of 0.4 mg/L maintained for at least four minutes. When used to oxidize pollutants which are only slowly reactive with ozone, measureable levels of dissolved ozone will be attained before the pollutant is removed. Therefore, the process must be controlled by relating the pollutant concentrations versus the amount of ozone required for their removal, under specific contacting conditions. Generally in wastewater treatment, the analytical methodology involves first knowing what pollutants are present to be ozonized, then how much ozone is required for their treatment using the contactor to be installed in the plant, then providing for monitoring of the amount of ozone applied and utilized, as well as the water or wastewater flow rate and pollutant strength. Usually, measurements of 'ozone' in actuality are measurements of molecular ozone plus other oxidants. These other oxidants are produced upon ozonation, and most are determined by the analytical reagents normally applied for the determination of molecular ozone. (See also W87-06492) (Lantz-PTT)
W87-06494

INTRODUCTION TO THE CHEMICAL REACTIONS OF OZONE PERTINENT TO ITS ANALYSIS,
Miami Univ., Oxford, OH. Dept. of Chemistry.
G. Gordon, and G. E. Pacey.
IN: Analytical Aspects of Ozone Treatment of Water and Wastewater, Lewis Publishers, Chelsea, Michigan. 1986. p 41-52, 1 tab, 30 ref.

Descriptors: *Ozone, *Wastewater treatment, *Water treatment, *Chemical reactions, Chemical properties, Ozonation, Oxygen.

The expanding use of ozone in water and wastewater treatment throughout the world continues to create considerable interest in the chemical reactions and analytical chemistry of ozone. Ozone has been shown to be a cost-effective oxidant and disinfectant which exhibits the additional capability of removing taste-, odor-, and color-producing compounds from drinking water. Before any new chemical can be accepted for water and wastewater treatment, several important criteria must be met. These include: easy generation of the oxidizing/disinfecting species, a detailed understanding of its associated decomposition reactions, and, in appropriate cases, an easily measured residual without complications from associated decomposition products or products of the water/wastewater treatment process itself. If ozonation, is to achieve wider application for water purification in the United States, accurate analytical procedures readily useable by technicians and water treatment plant operators are necessary. Ozone usually is generated by passing a stream of dry air or oxygen through an electrical discharge which converts only small portions of the oxygen to ozone. The very natural of ozone itself and its ease of self-decomposition makes all ozone measurements difficult. The instability of pure ozone precludes the preparation of weighed reference samples. Volatilization of ozone from solution, the rapid decomposition of ozone in water, and the reaction of ozone with most oxidizable trace contaminants in the water, with the reagents, or the glassware, all can cause large errors in ozone determination. (See also W87-06492) (Lantz-PTT)
W87-06495

METHODS OF DETERMINATION OF OZONE IN AIR AND IN WATER,
Societe Degremont, Rueil-Malmaison (France).
L. Brener.
IN: Analytical Aspects of Ozone Treatment of Water and Wastewater, Lewis Publishers, Chelsea, Michigan. 1986. p 53-70, 6 fig, 7 tab, 7 ref.

Descriptors: *Ozone, *Water quality control, *Chemical analysis, Wastewater treatment, Water treatment, Iodometry, Sodium thiosulfate, Sodium arsenite, Syringaldazine, Spectrophotometry, Ozonation.

No standardized method is available for the measurement of ozone in air. Thus, ozone may be measured in air by iodometry using two reducing agents to measure the iodine liberated: sodium arsenite or sodium thiosulfate. A study of these two methods shows that the sodium thiosulfate method (T) gives results which are always better than those of the arsenite method (A). A study of the ratio measurement of ozone by these two methods (r = T/A) shows that the ratio increases with the concentration of ozone. The difference may attain 30% for an ozone concentration of 85 mg/L. Although numerous methods for measurement of ozone in water are available, the iodometric method remains the most commonly used. A very sensitive reagent for iodine is available in the form syringaldazine, which was introduced initially as a reagent for free chlorine. Iodine liberated by ozone may be measured by syringaldazine, which takes on a rose-violet tint with maximum absorption at 585 nanometers. As a result, ozone may be determined spectrophotometrically at concentrations between 0 and 1.4 mg/L. (See also W87-06492) (Lantz-PTT)
W87-06496

ANALYSIS OF OZONE IN AQUEOUS SOLUTION,
North Carolina Univ. at Chapel Hill.
J. Stanley, and J. D. Johnson.
IN: Analytical Aspects of Ozone Treatment of Water and Wastewater, Lewis Publishers, Chelsea, Michigan. 1986. p 71-90, 4 fig, 1 tab, 46 ref.

Descriptors: *Chemical analysis, *Ozone, *Wastewater treatment, *Water quality control, Water treatment, Ozonation, Measuring instruments, Iodometry, Oxidation, Ultraviolet radiation, Colorimetry, Membrane processes.

The various analytical methods for ozone are reviewed, with considerable attention focusing on the two current standard procedures, iodometric oxidation and direct UV absorbance. Whenever possible, two independent procedures should be used: for example, a total oxidant method, such as an iodide-based amperometric titration using Flamm's buffer, the UV method, a membrane electrode, or a colorimetric procedure not using iodide. This approach minimizes the possibility that interfering substances will go undetected in many applications. It may also allow for more accurate determination of ozone concentration levels, since many techniques suffer from varying degrees of ozone loss during sample collection and preparation. When the iodometric procedure is employed, the effect of the purge step on the measurement should be examined by comparing it with direct addition of the sample to the potassium iodide. For highest sensitivity, amperometric endpoint titration amplifying the current from a rotating electrode is recommended. Shechter's photometric method of analysis is an acceptable alternative to the titration procedure in most cases. The UV-absorbance method is highly selective and can be sensitive (with 50-cm cells). It is one technique which does not suffer interference from oxidizing agents, although it must be pointed out that many halogen species and organics absorb UV light in the 200- to 300-nanometer range. The other colorimetric methods--DPD, LCV, FACTS, Indigo--are simple procedures for field applications and require little sophisticated or complicated equipment. The use of membrane electrode systems is encouraged. These cells offer an advantage of in-situ measurement with good sensitivity and potentially excellent selectivity. (See also W87-06492) (Lantz-PTT)
W87-06497

DETAILED COMPARISON OF ANALYTICAL METHODS FOR RESIDUAL OZONE MEASUREMENT,
Miami Univ., Oxford, OH. Dept. of Chemistry.
J. Grunwell, J. Benga, H. Cohen, and G. Gordon.
IN: Analytical Aspects of Ozone Treatment of Water and Wastewater, Lewis Publishers, Chelsea, Michigan. 1986. p 91-114, 13 fig, 6 tab, 39 ref.

Descriptors: *Chemical analysis, *Water quality control, *Ozone, Wastewater treatment, Water treatment, Monitoring, Titration, Ozonation, Reagents, Ultraviolet radiation, Electrochemistry, Electrodes.

Convenient laboratory analysis demands stable ozonated reagent solutions. With the DPD method, the ozone titer changed so rapidly with time, both for ozone in purified water and for ozone solutions with added hydrogen peroxide, that the method cannot be recommended for rou-

tine ozone analysis. The Arsenic(III) Back-Titration titer steadily increased for ozone solutions with added hydrogen peroxide. The ozone titer by the amperometric method with excess sodium thiosulfate increased 4% in nine minutes with ozone in purified water. The ozone titer determined by the arsenic (III) direct oxidation method and the Indigo method varied less than 3% over three hours, even with added hydrogen peroxide. The ozone titers differed among methods only when changes in the ozone-reductant reaction were involved. Conditions which reduce ozone decay prior to reaction with reductant reduced the scatter observed within a single method and reduced the differences observed among the analytical methods. All methods occasionally give a point 30-50% removed from that calculated on an otherwise smooth decay curve. This makes single point analysis for residual ozone untrustworthy. The Indigo method minimizes ozone decay by operating at pH 2. Buffers which slow ozone decay increase the ozone concentration determined by direct arsenic(III) oxidation. Multiple analyses of tap water or acid-stabilized ozone solutions show few differences. The direct measurement of the absorbance of aqueous ozone at 259 nanometers is the most straightforward and simplest ozone procedure. Here the absolute ozone concentration is based on the determination of the ozone absorption coefficient by comparison with an iodometric method. The Delta Scientific electrode failed to maintain calibration and failed to respond linearly over a 10 mg/L ozone range. No iodometric method is recommended. The Indigo method and the arsenic(III) direct oxidation method are the methods of choice. (See also W87-06492) (Lantz-PTT)
W87-06498

ANALYSIS OF OZONE IN AQUEOUS SOLUTIONS USING A MODIFIED IODOMETRIC TECHNIQUE WITH AS(III),
Vanderbilt Univ., Nashville, TN. Dept. of Chemical Engineering.
D. E. Sullivan, L. C. Hall, M. D'Ambrosi, and J. A. Roth.
IN: Analytical Aspects of Ozone Treatment of Water and Wastewater, Lewis Publishers, Chelsea, Michigan. 1986. p 115-128, 2 tab, 44 ref, append.

Descriptors: *Chemical analysis, *Iodometry, *Arsenic, *Ozone, *Water quality control, Wastewater treatment, Water treatment, Ozonation, Titration.

A modified iodometric procedure using an absorbing solution of 2% NBKI (neutral buffered potassium iodide) with a known amount of As(III) is described for 10 ml aqueous samples. Ozone contents from 0.5 to 65 mg O3/L were determined. High ozone concentrations also can be measured for generator calibration. This method gives results which are not significantly different than a boric acid method, but are for a modified standard methods procedure. Volatility of iodine has been completely eliminated. Stabilized samples do not make the time between sampling and final titration critical. (See also W87-06492) (Author's abstract)
W87-06499

DETERMINATION OF OZONE AND CHLORINE DIOXIDE IN WATER BY THE INDIGO METHOD,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
J. Hoigne, and H. Bader.
IN: Analytical Aspects of Ozone Treatment of Water and Wastewater, Lewis Publishers, Chelsea, Michigan. 1986. p 129-150, 9 fig, 5 tab, 16 ref, append.

Descriptors: *Ozone, *Chemical analysis, *Indigo method, *Water quality control, Water treatment, Wastewater treatment, Chlorine dioxide, Colorimetry, Ozonation.

The Indigo Method has been adapted for the measurement of ozone and chlorine dioxide in drinking water and in other aqueous solutions. This method is faster and of higher precision than the colorimetric methods which are generally applied in waterworks. In the pH region < or = to 4, one mole of ozone decolorizes 1.0 mole of aqueous sulfonated indigo. The stoichiometric factor stays constant even if concentrations varied in the range from 5 micrograms/L to 10 mg/L. The absorbance at 600 nanometers changes by - 20,000 when based on an addition of 1 mol/L ozone and a 1 cm cell. Chlorine dioxide is determined at pH > 4. The absorbance changes by - 7,000 - 9,000 per 1 mol/L of added chlorine dioxide. All calibration curves are linear. Reagents and oxidized reagents are quite stable. Hydrogen peroxide, organic peroxides, chlorite, chlorate, manganous ions and oxidized species in drinking water do not interfere with the determination. Chlorine is masked by malonic acid or glycine when ozone or chlorine dioxide are to be determined. Good photometers give a precision of 1.5%, or 2 micrograms/L. Visual methods have a limit of detection of about 10 micrograms/L. (See also W87-06492) (Author's abstract)
W87-06500

DETERMINATION OF OZONE IN WATER BY THE INDIGO METHOD; A SUBMITTED STANDARD METHOD,
Eidgenoeassische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
H. Bader, and J. Hoigne.
IN: Analytical Aspects of Ozone Treatment of Water and Wastewater, Lewis Publishers, Chelsea, Michigan. 1986. p 151-159, 1 fig, 6 ref.

Descriptors: *Ozone, *Indigo method, *Water quality control, *Pollutant identification, Chemical analysis, Ozonation, Water treatment, Wastewater treatment, Standards.

The indigo method for the determination of ozone as formulated for the new Swiss Standard Methods for Drinking Water Analysis is presented together with an international list of suppliers of indigo trisulfonate. Such a new selective and simple method will be needed in many countries because current methods for ozone analysis are generally non-selective when applied on real drinking waters or wastewaters. Ozone rapidly and stoichiometrically decolorizes indigo trisulfonate in acidic solution. The decrease in absorbance at 600 nanometers is linear with ozone residual and is 0.42 + or - 0.01 /cm/mg/L. The limits of detection are 2 micrograms/L for an instrumental method and 10 micrograms/L for a visual field method. (See also W87-06492) (Author's abstract)
W87-06501

MEASUREMENT OF RESIDUAL OZONE IN WATER - SPECIFICITY AND AUTOMATION,
Compagnie Intercommunale Bruxelloise des Eaux (Belgium).
W. J. Masschelein, G. Fransolet, R. Goossens, and L. Maes.
IN: Analytical Aspects of Ozone Treatment of Water and Wastewater, Lewis Publishers, Chelsea, Michigan. 1986. p 161-182, 11 fig, 17 ref.

Descriptors: *Ozone, *Water quality control, Automation, Potable water, Water treatment, Wastewater treatment, Ozonation, Chemical analysis, Monitoring, Peroxides.

Two methods specific for the determination of residual ozone in post-treatment purification of potable waters have been developed. One method involves spectrophotometry utilizing Acid Chrome Violet K. Under the practical conditions of ozonation, this colorant is specifically decolorized by ozone. As with chlorine, ozonides, and/or hydroperoxides and ultimately formed peroxides do not interfere. The second method is based on measurement of the depolarization current obtained, without interference by chlorine, by means of a nickel-silver galvanic couple. The two methods lend themselves to automation, but the first method is sequential, and the second is continuous and is thus better suited to in situ applications. (See also W87-06492) (Author's abstract)
W87-06502

TECHNIQUE OF CONTINUOUS ELECTROCHEMICAL MEASUREMENT OF RESIDUAL ACTIVE OXIDANTS (RAO) IN WATERS,
Compagnie Intercommunale Bruxelloise des Eaux (Belgium).
W. J. Masschelein, and G. Fransolet.
IN: Analytical Aspects of Ozone Treatment of Water and Wastewater, Lewis Publishers, Chelsea, Michigan. 1986. p 183-199, 14 fig, 7 ref.

Descriptors: *Water treatment, *Electrochemistry, *Residual active oxidant, *Water quality control, Chlorine, Chloramines, Carbon dioxide, Ozone, Silver, Copper, Gold, Electrodes, Drinking water.

galvanic couples which allow the continuous determination of residual active oxidants (RAO) in waters, such as chlorine, chloramines, chlorine dioxide, and/or ozone were examined. Two couples have proved to be quite feasible: (1) Au/Cu: Adequate for qualitative indications influenced by the nature of the oxidants, but not for the precise measurement of their concentrations. Additionally, this couple provides residual impedance current; (2) Au/Ag: This couple does not provide significant residual current, but the diffusion current is less important. The addition of iodide to the medium allows an easy and reliable gross determination of the RAO. The technique described can be adjusted for control of quality and, consequently, for the treatment of (drinking) water. It can be applied to other commercial sectors provided that poisoning of the electrodes is avoided. (See also W87-06492) (Author's abstract)
W87-06503

MEASUREMENT AND REGULATION OF OZONE IN THE PRESENCE OF CHLORINE,
Societe Degremont, Rueil-Malmaison (France).
Y. Richard, and L. Brener.
IN: Analytical Aspects of Ozone Treatment of Water and Wastewater, Lewis Publishers, Chelsea, Michigan. 1986. p 201-222, 13 fig, 9 ref.

Descriptors: *Ozone, *Water quality control, *Chlorine, *Water treatment, *Wastewater treatment, Monitoring, Electrodes, Nickel, Silver, Colorimetry. Ozonation.

Disinfection treatment of a water by ozone requires the presence of 0.4 mg/L over four minutes. This is possible only if one utilizes a selective and precise method for determining ozone at the exit of the contact towers. It is possible to separate ozone from chlorine in mixture with ozone by colorimetric measurement. Study of a nickel-silver electrode couple also allows selective determination of ozone in the presence of chlorine. Nevertheless, this couple is sensitive to variations in the nature of chlorine. In order to obtain good agreement between the colorimetric determination and the electrochemical determination, it is necessary to introduce ammonium chloride so as to have the presence of chloramine. (See also W87-064892) (Lantz-PTT)
W87-06504

DETERMINATION OF RESIDUAL OZONE IN WATER AND MIXTURES OF OZONE WITH FREE AND COMBINED CHLORINE, CHLORIDE DIOXIDE, AND CHLORITE,
A. T. Palin.
IN: Analytical Aspects of Ozone Treatment of Water and Wastewater, Lewis Publishers, Chelsea, Michigan. 1986. p 221-229, 6 ref, append.

Descriptors: *Water quality control, *Ozone, *Chlorine, *Chlorine dioxide, *Water treatment, *Wastewater treatment, *Chlorite, Titration, Chemical analysis, Colorimetry, DPD method.

The DPD method for determining free and combined chlorine in water is applicable also to residual ozone. The colors are titrated with standard ferrous ammonium sulfate solution or measured colorimetrically. Dietyl-p-phenylenediamine (DPD) is used as indicator with suitable additional reagents for the differential analysis of mixtures. Analysis for ozone can be conducted in the presence of free and combined chlorine, chlorine diox-

ide, and/or chlorite, with separate determination of each of these oxidants. The DPD methods are valid for the titration of solutions containing < 5mg/L of chlorine or equivalent oxidants; dilute in order to obtain a total volume of 100 mL. The dose of 0.5 gm of DPD powder No. 1 recommended must be dissolved initially in the volume of water necessary for the dilution studied. It is only then that the appropriate volume of water to be analyzed is added and mixed. For the colorimetric methods, the threshold of 5 mg/L can be exceeded with the reservation of increasing the dose of DPD powder No. 1 (the limit of 10 mg/L must not be exceeded, since starting with 20 mg/L of chlorine, one observes decoloration of the pills or of the powder in the course of dissolution). In titrimetry, 5 mg/L is a limit not to be exceeded without dilution. (See also W87-06492) (Lantz-PTT)
W87-06505

PHOTOMETRIC DETERMINATION OF OZONE AT LOW CONCENTRATIONS WITH DIETHYL-P-PHENYLENEDIAMINE,
Miami Univ., Oxford, OH. Dept. of Chemistry.
E. Gilbert.
IN: Analytical Aspects of Ozone Treatment of Water and Wastewater, Lewis Publishers, Chelsea, Michigan. 1986. p 231-244, 7 fig, 4 tab, 45 ref.

Descriptors: *Water quality control, *Ozone, *Photometry, Chemical analysis, DPD method, Iodides, Iodine, Spectrophotometry.

A spectrophotometric method is described for the determination of ozone at low concentrations (0.02-2.5 mg/L O3) in water with N,N-diethyl-1,4-phenylenediamine (DPD). The method depends on the decomposition of ozone with the iodide ion, forming iodine, which with DPD forms a red dye which can be measured spectrophotometrically in the 500-550 nanometer region. The conditions of analysis are described and advantages and disadvantages of the method are discussed. The spectrophotometric determination of ozone in water with the help of DPD shows a sensitivity of measurement. The greatest disadvantage, which holds for all iodometric procedures in the aqueous phase, is its low selectivity, since besides ozone a series of oxidants found in ozonized waters, such as H2O2, organic peroxides, KMnO4, and bromine, also can oxidize free iodide ion. The extent to which these oxidants can occur in natural waters can vary greatly. In a comparison of different methods of ozone determination with the DPD method, the results obtained by the DPD method, therefore, can correspond or also deviate, according to the materials contained. (See also W87-06492) (Lantz-PTT)
W87-06506

EVALUATION OF ANALYTICAL METHODS FOR DISSOLVED OZONE IN NATURAL WATERS AND WASTEWATER,
North Carolina Univ. at Chapel Hill.
J. D. Johnson, J. Hoigne, H. Bader, and J. W. Stanley.
IN: Analytical Aspects of Ozone Treatment of Water and Wastewater, Lewis Publishers, Chelsea, Michigan. 1986. p 257-265, 5 fig, 10 ref.

Descriptors: *Ozone, *Chemical analysis, *Water quality control, Wastewater treatment, Water treatment, Surface water, Wastewater effluent, Electrodes, Indigo method, DPD method, Titration, Ultraviolet radiation.

Several analytical procedures for analysis of ozone in water are compared using surface water and wastewater effluent samples. The selectivities of the methods for ozone in the surface water samples was observed to be (in order of decreasing selectivity): membrane electrode, indigo, and DPD. DPD was the least selective of the methods considered, probably as a result of the non-selective iodide ion oxidation step. In the wastewater effluent examined, all three methods appeared to suffer little or no interferences, and the utility of the membrane electrode for molecular O3 in this medium was confirmed. Estimation of the detection limits of the methods found the membrane electrode, indigo and DPD techniques to be approximately equal. The UV procedure and direct iodometric titration technique were less sensitive at ppb levels. Of the methods best suited for individual or discrete sample measurements, the indigo procedure is superior to the less selective DPD procedure. Both procedures are equally sensitive and are applicable to the measurement of concentrations from 0.02 mg/L in polluted waters to 0.002 mg/L, or 2 ppb, in clean water. The membrane electrode and differential UV procedures are much more suited for on-line process analyzers, although the UV method is relatively insensitive and in polluted waters requires complex instrumentation for differential measurements. Both of these procedures are much more difficult to apply reliably for single sample measurements. (See also W87-06492) (Lantz-PTT)
W87-06508

OZONE DOSAGE CONTROL,
Hankin Environmental Systems, Scarborough (Ontario).
D. MacKay.
IN: Analytical Aspects of Ozone Treatment of Water and Wastewater, Lewis Publishers, Chelsea, Michigan. 1986. p 267-269, 1 fig.

Descriptors: *Ozone, *Water treatment, *Ozonation, Drinking water, Measuring instruments, Water quality control, Amperometry, Colorimetry, Chlorine, Microprocessors.

Efficient use of ozone in the treatment of drinking water requires an appropriate and reliable means of automatic dosage control. Traditionally, ozone dosage has been based on maintaining a prescribed ozone residual in the water for a certain length of time. This still is the best method available to ensure sterilization, but its implementation poses some serious practical problems, and it can be unnecessarily expensive in terms of energy consumption if the objective of ozonation is, for example, reduction in color levels. The simplest means of control is to vary the rate of application of ozone in direct proportion to the flow of water. Dosage based on residual ozone concentrations in water usually depends on an amperometric analyzer whose use presents several difficulties. Ideally, a residual ozone analyzer should work on the UV absorption principle with a submersible probe, using unozonated process water as a zero contacting basin with provision made to remove the probe for cleaning the optics. If reduction of color levels is the primary objective, then a colorimeter measuring light absorption at 370 nanometer can provide a good feedback parameter. If ozone is being used to reduce levels of THMs, it is suggested that residual chlorine levels be investigated as a possible control parameter. The advent of intelligent (microprocessor-based) process controllers adds a new dimension to ozone dosage control. Because of the long delay times inherent in ozone contacting systems, conventional controllers based on only one measured parameter have a difficult time responding properly to perturbations in the process. A programmable control system can be taught to weigh all the available information and compute the dosage necessary to ensure adequate treatment at any time. Alternatively, it could prescribe a dosage based on an empirical relationship derived from operating experiences. (See also W87-06492) (Lantz-PTT)
W87-06509

CONTROL OF OZONE DISINFECTION BY EXHAUST GAS MONITORING,
Environmental Protection Agency, Cincinnati, OH. Water Engineering Research Lab.
A. D. Venosa, and M. C. Meckes.
IN: Analytical Aspects of Ozone Treatment of Water and Wastewater, Lewis Publishers, Chelsea, Michigan. 1986. p 303-314, 5 fig, 2 tab, 11 ref.

Descriptors: *Ozone, *Wastewater treatment, *Disinfection, *Monitoring, Water quality control, Ozonation, Gas chromatography, Flow rates, Chemical analysis.

This paper demonstrates empirically that disinfection of municipal wastewater with ozone can be controlled by monitoring the exhaust gas ozone concentration exiting the contactor. This method is more reliable than measuring dissolved ozone because of the inherent difficulties and inadequacies of state-of-the-art dissolved residual techniques. The advantages of measuring exhaust gas ozone are summarized as follows: True ozone is being measured, free of interferences; ozone demand of the effluent and transfer efficiency of the contactor are automatically accounted for in one measurement; the method is easily automated; instruments are already available for measuring ozone in the gas phase with accuracy, precision, and low level sensitivity; and ozone is more stable in the gaseous phase than in the liquid phase, and consequently the operator does not have to concern himself with dissipation of the ozone from the time it leaves the contactor to the time it arrives at the analyzer. It is emphasized that exhaust gas monitoring is applicable only if the gas-to-liquid flow ratio is held constant. The control loop then is envisioned as follows: a flow-proportional measurement signals a change in the gas flow rate from the ozone generator to the contactor as the liquid flow rate changes, thereby keeping the ratio constant; and, as ozone concentration in the exhaust gas changes either as a result of a change in demand of the effluent or a change in flow conditions, a signal is sent to the ozone generator to change the power or frequency input accordingly. Thus, disinfection is controlled easily, reliably, and with confidence. The effect this control strategy has on the cost of ozone production has yet to be evaluated. The data were obtained using a plug flow bubble diffuser contactor. There is no reason to believe, however, that the control strategy would not be applicable to other types of ozone contactors as well. (See also W87-06492) (Lantz-PTT)
W87-06512

INSTRUMENTS FOR ANALYSIS OF OZONE IN AIR AND WATER,
Rice International Consulting Enterprises, Aston, MD.
For primary bibliographic entry see Field 7B.
W87-06513

EXAMPLE OF AUTOMATIC REGULATION OF OZONE PRODUCTION - THE PLANT AT NANTES LA ROCHE (FRANCE),
P. Fontalirant, M. Pare, and J. Gublais.
IN: Analytical Aspects of Ozone Treatment of Water and Wastewater, Lewis Publishers, Chelsea, Michigan. 1986. p 345-356, 4 fig.

Descriptors: *Water treatment facilities, *Nantes La Roche, *France, *Water quality control, *Water treatment, *Ozone, Ozonation, Chemical analysis, Amperometry, Sampling, Monitoring, Mathematical studies.

The drinking water treatment plant at Nantes la Roche is designed to treat a maximum daily throughput of 280,000 cu m/day (52.8 mgd) of water. The ozone plant is capable of providing a treatment rate greater than 2.5 g/cu m with a production of 30 kg of ozone per hour. This plant is fitted with an automatic control device, the function of which is to maintain a constant percentage of ozone at the outlet of the contact vessels. Production of ozone may be varied by adjusting the operating voltage of the ozone generators, as well as the speed of the air boosters. Residual ozone in the water is measured continuously by an amperometric analyzer. The value measured is compared continuously with a predetermined set point. A signal error, is thus defined, which participates in the determination of a new treatment rate. The regulator is one of the 'disturbing magnitude' type, in that it takes directly into account the measurement of the water flow to be treated, working out at each moment an equation which is representative of the quantity of ozone produced. In addition, the variations of the flow which modify the time constant process, directly affect the frequency of sampling. Two years of use have shown that the supplementary investment involved with this equipment, finds its justification in the great flexibility of operation, its rigor of treatment and its functioning at optimal conditions of energetic yield. (See also W87-06492) (Lantz-PTT)

W87-06514

AUTOMATED PROCEDURE FOR MONITORING THE EFFECTIVENESS OF OZONATION PROCESSES,
Centre de Recherche Lyonnaise des Eaux - Degremont, Le Pecq (France).
J. P. Duguet, E. Brodard, M. Roustan, and J. Mallevialle.
IN: Analytical Aspects of Ozone Treatment of Water and Wastewater, Lewis Publishers, Chelsea, Michigan. 1986. p 357-374, 13 fig, 4 tab, 11 ref.

Descriptors: *Ozonation, *Water treatment, *Water quality control, *Automation, Ultraviolet radiation, Absorption, Spectrophotometry, Ozone, Hydrogen peroxide, Chemical analysis, Chemical reactions.

Automation of the ozonation process based on the reduction in levels of organic matter can be accomplished easily when ozonation is monitored by UV absorption of the treated water. This measurement can be obtained easily by a spectrophotometer with automatic sampling and destruction of ozone residual. The desired reduction in UV absorbance is obtained by modifications of ozone concentrations to respond to changes in water flow rate and concentrations of organics. With different waters, the kinetic constant determined by UV absorption changes with each month of the year. The reduction of UV absorption values may be redefined periodically to obtain the desired effect. The addition of hydrogen peroxide to water during ozonation increases the rate of reduction of UV absorbance; thus ozone transfer occurs faster. Coupling ozone and hydrogen peroxide increases the efficiency of the treatment, as evidenced by a reduction in concentrations of trihalomethane precursors. The quantity of hydrogen peroxide added may be automated to respond to the water flow rate. The use of a microprocessor which integrates values such as input and output UV absorbance, percent reduction, water flow rate, ozone concentration, and quantity of hydrogen peroxide added will permit the optimization of an ozone process. (See also W87-06492) (Lantz-PTT)
W87-06515

AUTOMATION OF A PLANT TREATING WATER WITH OZONE,
Societe Degremont, Rueil-Malmaison (France).
R. Louboutin.
IN: Analytical Aspects of Ozone Treatment of Water and Wastewater, Lewis Publishers, Chelsea, Michigan. 1986. p 383-389, 2 fig, 5 ref.

Descriptors: *Automation, *Water treatment facilities, *Ozone, *Water treatment, *Management planning, Computers, Ozonation, Contactor tanks, Flow rate, Economic aspects, Optimization.

An entirely automated water treatment plant using ozone is described. It is demonstrated how, in this particular case, the use of advanced automation techniques makes possible an approach to optimized investment and running costs. The particularly powerful means supplied by commercial microcomputers have made it possible to build this two-stage ozonation plant designed to ensure the chemical demand in oxidizing agent of the water in a first step, and the viricidal action of this oxidizing agent in a second step. This implied in the first place that a certain residual ozone concentration was to be maintained at the outlet of each contactor tank, regardless of the treated flow rate. In fact, because of the small quantity of reserves, this flow rate varied from 600 to 4,000 cu m/hr with relatively short periodicity in variations. On the other hand, it was also necessary to take into account the possible variations with time, not only in the total ozone demand of the water, but also in the distribution of this demand between the two contactor tanks. The solution to be adopted to comply with the various constraints inherent to the conditions of application of this process obviously had to be selected while taking into account the plant running requirements: optimization of production costs, high reliability of the equipment ensuring a safe supply of water, top quality and sufficient quantities, to the user. As it was reasonable to anticipate an increasing demand in the future, the treatment plant had to be so designed that successive extensions would be easily feasible. After a thorough analysis of the problem as a whole, it was concluded that the plant best suited to comply with the above-mentioned criteria with optimized cost had to be highly automated in order to minimize investments related to the ozone production equipment. This aim was reached by using particularly efficient means made available by commercial microprocessor techniques. (See also W87-06492) (Lantz-PTT)
W87-06517

BIOFILM DYNAMICS AND KINETICS DURING HIGH-RATE SULFATE REDUCTION UNDER ANAEROBIC CONDITIONS,
Aalborg Universitetscenter (Denmark). Environmental Engineering Lab.
P. H. Nielsen.
Applied and Environmental Microbiology AEMIDF, Vol. 53, No. 1, p 27-32, January 1987. 5 fig, 1 tab, 36 ref. Danish NSF Grant 16-3677.H-747.

Descriptors: *Wastewater treatment. *Biological wastewater treatment, *Anaerobic conditions, *Bacteria, *Model studies, *Biofilms, *Sulfates, *Sulfides, *Kinetics, Anaerobic bacteria, Temperature effects, Dynamics, Temperature, Chemical reduction, Filters, Mathematical equations.

The sulfate kinetics in an anaerobic, sulfate-reducing biofilm were investigated with an annular biofilm reactor. Biofilm growth, sulfide production, and kinetic constants (K sub m and V sub max) for the bacterial sulfate uptake within the biofilm were determined. These parameters were used to model the biofilm kinetics, and the experimental results were in good agreement with the model predictions. Typical zero-order volume rate constants for sulfate reduction in a biofilm without substrate limitation ranged from 56 to 93 micromol of SO4(2-)/cu cm/h at 20 C. The temperature dependence of sulfate reduction was equivalent to 3.4 at between 9 and 20 C. The measured rates of sulfate reduction could explain the relatively high sulfide levels found in sewers and wastewater treatment systems. Furthermore, it was shown that sulfate reduction in biofilms just a few hundred microns thick is limited by sulfate diffusion into biofilm at concentrations below 0.5 mM. This observation might, in some cases, be an explanation for the relatively poor capacity of the sulfate-reducing bacteria to compete with the methanogenic bacteria in anaerobic wastewater treatment in submerged filters. (Author's abstract)
W87-06543

ECOPHYSIOLOGICAL ADAPTATIONS OF ANAEROBIC BACTERIA TO LOW PH: ANALYSIS OF ANAEROBIC DIGESTION IN ACIDIC BOG SEDIMENTS,
Wisconsin Univ.-Madison. Dept. of Bacteriology.
For primary bibliographic entry see Field 5A.
W87-06544

CLARIFIER TUNE-UP,
New York State Dept. of Environmental Conservation, Albany. Bureau of Wastewater Facilities Operations.
J. K. Esler, and T. J. Miller.
Operations Forum, Vol. 4, No. 1, p 7-11, January 1987. 3 fig.

Descriptors: *Clarifiers, *Wastewater treatment, *Maintenance, *Optimization, Weirs, Sludge bed, Activated sludge, *Flow measurement, New York, Performance evaluation.

Methods of optimizing clarifier performance are discussed. Periodic maintenance (especially after dewatering, which allows fuller examination of mechanical parts) is stressed. Other points covered are: sludge blanket level control, return flow sludge control, scum removal, and control of settleability. Some methods and important aspects of clarifier performance analysis are discussed, including the use of dyes as flow pattern indicators. The importance of flow measurement is emphasized. Obvious, straightforward field modifications can often effect necessary improvements while avoiding expensive approaches, such as an increase in hydraulic capacity. The authors briefly discuss their recent work with clarifiers at two wastewater treatment plants in New York State, at Syracuse and Herkimer. (Airone-PTT)
W87-06564

BAFFLING SOLUTION,
D. Seymour.
Operations Forum, Vol. 4, No. 1, p 12-13, January 1987. 1 tab.

Descriptors: *Clarifiers, *Baffles, *Settling tanks, *Flocculation, *Wastewater treatment, Wastewater treatment plants, Activated sludge process, Oswego.

The construction and use of baffles in the settling tanks of a wastewater treatment plant in Oswego, NY are described. The chief cause of a persistent floc problem was identified in the shallowness (8 feet) of the settling tanks. Baffles (made from pressure-treated lumber and plywood) improved the effectiveness of the tanks to the point where the plant's chlorine contact tanks no longer needed to serve as additional settling tanks, a use which required extra maintenance. (Airone-PTT)
W87-06565

MORE ON SLUDGE WASTING,
Salina Area Vocational-Technical School, KS.
T. Hobson.
Operations Forum, Vol. 4, No. 1, p 14-19, January 1987.

Descriptors: *Retention time, *Activated sludge process, *Settling tanks, *Wastewater treatment, *Temperature effects, Foaming, Settleable solids, Mixed liquor solids, Color removal, Clarifiers.

The control of activated sludge wasting is discussed. A list of parameters important in determining sludge condition includes: amount and color of foam, settleability and color of mixed liquor, types of sludge solids on the surface of the final clarifier, concentrations of mixed liquor solids, and amount of sludge in the final clarifier. The author discusses each test or observation, explaining how to include it in the evaluation of the proper sludge wasting rate. Temperature (i.e., season of the year) influences wasting: generally sludge 'age' should be increased by 20-50% for the northern U.S. in January and February. A simple method for calculating wasting, applicable to small plants where analytical time is limited is included. (Airone-PTT)
W87-06566

UNDERSTANDING CHEMICAL HAZARDS,
WVP Corp., Decatur, IL.
L. Niedringhaus, and L. Niedringhaus.
Operations Forum, Vol. 4, No. 1, p 20-24, January 1987. 6 fig, 1 tab, 6 ref.

Descriptors: *Training, *Education, *Hazardous materials, *Wastewater treatment plants, *Operating policies, *Safety, Sewers, Accidents, Chemical reactions, Organic compounds, Radioactive wastes.

Treatment plant operators are at risk from numerous hazardous chemicals in the work environment. Accidental spills from industrial sources, chemicals used as part of the treatment process, and chemicals created by reactions in the sewers and during the treatment process all pose hazards. All operators should be informed of possible hazards, have access to safety and monitoring equipment, and have a plan of action to deal with any chemical emergency that might occur. Although planned educational workshops and seminars about hazardous chemicals are important, operators need to take responsibility for self-education. All operators need to investigate possible sources of chemical hazards tributary to the treatment plant. This includes a working knowledge of local industries including hospitals and laboratories, a knowledge of what chemicals are commonly transported by

rail and truck through the surrounding area, and an understanding of the various labeling systems used to identify hazardous chemicals. (The U.S. DOT system, 704M system, and the U.N. hazard classification are all briefly discussed.) (Airone-PTT)
W87-06567

AQUATIC SYSTEM FOR FUEL AND FEED PRODUCTION FROM LIVESTOCK WASTES,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
E. P. Lincoln, B. Koopman, L. O. Bagnall, and R. A. Nordstedt.
Journal of Agricultural Engineering Research JAERA2, Vol. 33, No. 3, p 159-169, March 1986. 3 fig, 3 tab, 28 ref.

Descriptors: *Wastewater treatment, *Biogas, *Anaerobic digestion, *Fuel production, *Feed production, *Livestock wastes, Methanogenic bacteria, Photosynthetic bacteria, Microalgae, Macrophytes, Methane, Recycling, Swine, Solid wastes, Algal growth, Nutrients, Water hyacinth, Animal wastes.

A multistage aquacultural system based on methanogenic bacteria, photosynthetic bacteria, microalgae, and floating macrophytes was developed to produce methane, protein supplements, and fibrous feeds from swine wastes under subtropical climatic conditions in the southeastern United States. Average biogas yield from anaerobic digestion of settled waste solids at ambient temperature was 0.27 cubic m/kg volatile solids added with an average methane content of 68%. Treatment of raw and anaerobically digested swine waste by photosynthetic bacteria produced liquid medium suitable for algae production. Algal growth potential of this medium was improved by harvesting the bacteria. A carbon and nitrogen balance calculated for the algal stage of the system indicated that it was possible to recycle 50% of the waste nitrogen as protein. Equipment and procedures for harvesting and processing water hyacinth were investigated with special reference to their energy consumption and yield. (Author's abstract)
W87-06594

PLANT MAINTENANCE PROGRAM,
Water Pollution Control Federation, Washington, DC.
J. H. Austin, H. Fenske, A. Holst, E. R. Jones, and R. F. Layton.
Manual of Practice OM-3, Operations and Maintenance. Water Pollution Control Federation, Washington, DC. 1982. 112 p, 31 fig, 9 tab, 90 ref, append.

Descriptors: *Maintenance, *Wastewater treatment, *Wastewater facilities, *Wastewater management, *Management planning, Performance evaluation, *Cost analysis, Maintenance costs, Training, Automation, Process control, Personnel management.

This manual examines the procedures for establishing and coordinating a maintenance management system for wastewater treatment facilities. Chapter 1 presents a maintenance management efficiency evaluation to determine what type of maintenance management system is needed. Chapter 2 discusses the scope, structure, and functions of a maintenance department and the responsibilities of its personnel. Chapter 3 addresses matching of available personnel, equipment, and budgets with workloads. In Chapter 4, the factors governing whether maintenance or repair should be done in-house or by contract are presented. Chapter 5 gives information on the organization and management of an inventory program and includes methods for estimating the costs of purchasing and storing material. Guidelines for the establishment, implementation, and operation of a preventive maintenance program are presented in Chapter 6. Chapter 7 emphasizes the importance of establishing good channels of communication between operations and maintenance departments. Chapter 8 discusses instrumentation maintenance, and Chapter 9 explores the use of computerized systems for maintenance management. All aspects of employee training, including safety, are discussed in Chapter 10. Considerations for evaluating maintenance performance are presented in Chapter 11. (Geiger-PTT)
W87-06606

CLARIFIER DESIGN,
Water Pollution Control Federation, Washington, DC.
M. Augustus, J. M. Baker, C. Chen, G. T. Daigger, and D. M. Griffith Jr.
Manual of Practice FD-8, Facilities Development. Water Pollution Control Federation, Washington, DC. 1985. 103 p, 63 fig, 22 tab, 115 ref.

Descriptors: *Clarifiers, *Clarification, *Design criteria, *Wastewater treatment, *Settling basins, Sedimentation, Activated sludge, Weirs, Performance evaluation, Flocculation, Chemical precipitation, Separation techniques, Sedimentation basins.

The purpose of this manual is to discuss the significant design aspects of primary and secondary clarifiers for wastewater treatment plants. Chapter 1 discusses gravity sedimentation which occurs in clarifiers. Grit chambers and primary clarifiers are used to remove the settlable suspended solids in raw wastewaters. Secondary clarifiers are used to remove the settlable suspended solids created in biological treatment processes such as the activated sludge and trickling filter process. Chapter 2 reviews various types of wastewater solids suspensions, types of settling (discrete, flocculant, hindered or zone settling, and compression settling), effects of flow variation on clarifier design, clarifier hydraulics, and factors affecting the performance of clarifiers (hydraulic loading rate, solids loading rate, and clarifier depth). Chapter 3 reviews the types of circular clarifiers (center feed, peripheral feed, and bottom feed), sludge collectors, and skimmers. In chapter 4, the typical hydraulic flow patterns of the rectangular clarifier are discussed along with the advantages and disadvantages of various recatangular clarifier design parameters of the inlet, outlet, sludge hopper, and sludge collector. (Geiger-PTT)
W87-06607

ENERGY CONSERVATION IN THE DESIGN AND OPERATION OF WASTEWATER TREATMENT FACILITIES,
Water Pollution Control Federation, Washington, DC.
R. W. Crites, M. J. Dean, R. F. Luthy, K. R. Marston, and A. B. Pincince.
Manual of Practice No. FD-2, Facilities Development. Water Pollution Control Federation, Washington, DC. 1982. 129 p, 66 fig, 46 tab, 104 ref.

Descriptors: *Wastewater treatment, *Wastewater facilities, *Operating costs, *Waste recovery, *Recycling, Cost analysis, Energy conversion, Composting, Waste disposal, Wastewater disposal, Sludge disposal, Sludge utilization, Activated sludge, Design criteria, Wastewater renovation.

This manual provides the design engineer or treatment plant manager with basic information and guidance for making intelligent decisions on energy-related subjects and identifies areas where additional study may be warranted for a particular wastewater plant operation. Chapter 1 reviews basic energy concepts and units and defines primary and secondary energy use in wastewater treatment. Chapter 2 discusses energy used for construction of wastewater facilities, energy used to produce and deliver treatment chemicals, and energy considerations for facilities design and operation. Energy use for pumping, preliminary treatment, biological wastewater treatment, chemical treatment, granular media filtration, activated carbon adsorption and regeneration, disinfection, and sludge treatment and disposal are examined. Chapter 3 addresses energy recovery and reuse in the form of wastewater reclamation, fuel production (anaerobic digestion and sludge pyrolysis), fuel utilization, and waste heat recovery (steam systems and hot water systems). Chapter 4 presents an organizational structure for facility energy management and examines case histories of the following wastewater facilities where energy conservation plans proved beneficial: Schenectady, Rochester, and Auburn, New York; Clark County, Nevada; Los Angeles County Sanitation Districts and Laguna Niguel, California; and the Southerly Wastewater Treatment Plant, Cleveland, Ohio. (Geiger-PTT)
W87-06608

SLUDGE STABILIZATION,
Water Pollution Control Federation, Washington, DC.
S. E. Aasheim, S. B. Ahlstrom, S. K. Banerji, E. Epstein, and R. T. Haug.
Manual of Practice FD-9, Facilities Development. Water Pollution Control Federation, Washington, DC. 1985. 106 p, 42 fig, 36 tab, 158 ref.

Descriptors: *Sludge stabilization, *Anaerobic digestion, *Aerobic digestion, *Composting, *Design criteria, *Sludge digestion, Lime, Sludge disposal, Sludge drying, Dewatering, Sludge conditioning, Sludge thickening, Comparison studies, Land disposal, Digested sludge, Wastewater treatment, Aeration.

This manual emphasizes stabilization theory, research results, and process design for the more commonly used wastewater sludge stabilization processes: anaerobic digestion, aerobic digestion, composting, and lime stabilization. Chapter 1 discusses the design approach to sludge stabilization processes in terms of the quantities of sludge to be treated, the integration of the stabilization process with liquid and other solids related processes, the objectives for the stabilization process, and safety. The advantages and disadvantages of anaerobic digestion, aerobic digestion, composting, and lime stabilization are presented. Chapter 2 discusses the basic theory of anaerobic digestion and analyzes unit process design and physical facilities. Chapter 3 considers process design and operational problems of aerobic digestion and discusses such process variations as high purity oxygen aeration, thermophilic aerobic digestion, and low-temperature aerobic digestion. The basic theory of composting is presented in chapter 4, along with stabilization and process design criteria, a description of physical facilities required, and materials balances of the composting process. Examples of composting operations in the Metropolitan Denver Sewage Disposal District No. 1 and in the Hampton Roads Sanitation District are given. Chapter 5 presents the basic theory of lime stabilization, its objectives, process design criteria, physical facilities, and operating, chemical and energy requirements. Several process alternatives for lime stabilization are considered. Chapter 6 compares different stabilization processes by criteria of volatile solids content, specific oxygen uptake rate, and pathogen indicator organism reduction. Stabilization is discussed in relation to the impact of sludge use in land applications and sludge disposal in landfills. (Geiger-PTT)
W87-06609

OPERATION OF EXTENDED AERATION PACKAGE PLANTS,
Water Pollution Control Federation, Washington, DC.
J. R. Brown, R. E. Burton, C. F. Herbert, D. J. Jacobson, and C. E. Miller.
Manual of Practice OM-7, Operations and Maintenance. Water Pollution Control Federation, Washington, DC. 1985. 95 p, 41 fig, 3 tab, 40 ref.

Descriptors: *Wastewater treatment, *Aeration, *Wastewater facilities, *Maintenance, *Activated sludge process, Biological wastewater treatment, Clarification, Disinfection, Sludge disposal, Safety, Corrosion control, Sand filters, Filtration, Advanced wastewater treatment.

This manual provides a nontechnical explanation of the operation and maintenance of a package extended aeration wastewater treatment plant for operators responsible for plants with a design flow of up to 5 liters/sec. Topics covered include: installation, flow equalization, protective devices (bar screens, comminutor, trash trap, grease trap, and electrical motor phase monitors), aeration chamber and clarifier operation, sludge wasting, disinfection, operating tests and routine mainte-

nance (settleability, pH, color, dissolved oxygen, residual chlorine, and flow), advanced unit processes (intermittent sand filters, microstrainers, rapid sand filters, polishing pond, phosphorus removal, post aeration, and nitrogen removal), corrosion control, regulatory requirements, and safety. This manual should be used in conjunction with the manufacturer's Operations and Maintenance manual, and contains a glossary of terms pertaining to wastewater treatment. (Geiger-PTT)
W87-06612

PROCESS INSTRUMENTATION AND CONTROL SYSTEMS,
Water Pollution Control Federation, Washington, DC.
H. W. Bierig, R. A. Davis, H. D. Gilman, D. J. Hexom, and D. I. Knudsen.
Manual of Practice OM-6, Operations and Maintenance. Water Pollution Control Federation, Washington, DC. 1984. 161 p, 64 fig, 25 tab, 47 ref, 4 append.

Descriptors: *Process control, *Automation, *Maintenance, *Control systems, *Computers, Hydraulic equipment, Flowmeters, Gages, Project planning, Wastewater treatment, Training, Performance evaluation, Monitoring, Sensors, Design criteria.

This manual is designed to meet the needs of instrument users of the operation and maintenance staffs in wastewater treatment plants. Benefits that can be achieved with instruments and what can be expected from instruments are described. Reasons for instrument malfunction are suggested for pressure, level, and flow measuring instruments. A preventive maintenance program for instruments is outlined, along with management methods and technical guidelines. A time-proven troubleshooting technique is presented to help identify the source of instrument problems. A plan for instrumentation and control system emergency response evaluation is also discussed. Explanations are provided on how to read instrumentation and control system drawings. Methods for instrumentation and control system training are outlined. Additional sources of training information and professional activities in this field are given. (Geiger-PTT)
W87-06613

SIMPLIFIED LABORATORY PROCEDURES FOR WASTEWATER EXAMINATION,
Water Pollution Control Federation, Washington, DC.
B. S. Dhaliwal, M. M. Grimes, H. T. Neketin, J. Peterson, and D. Richard.
Third Edition. Water Pollution Control Federation, Washington, DC. 1985. 105 p, 55 fig, 14 tab, 2 append.

Descriptors: *Wastewater analysis, *Wastewater treatment, *Testing procedures, *Process control, *Sampling, Monitoring, Hydrogen ion concentration, Alkalinity, Dissolved oxygen, Biochemical oxygen demand, Nitrogen, Suspended solids, Chlorine, Coliforms, Laboratory equipment.

This manual was prepared as a supplement to 'Standard Methods' to provide a simplified guide for operators and technicians of smaller wastewater treatment plants. The introductory chapter discusses sample collection, laboratory equipment, reagents, and laboratory safety. Chapter 2 discusses volumetric, gravimetric, colorimetric, and electrometric analysis, and accuracy, precision, and quality assurance. Chapter 3 describes simplified laboratory tests for settleable matter; pH; volatile acids; total alkalinity of wastewater and sludge; suspended matter - total nonfilterable residue; volatile and fixed residue in wastewater; and total solids, volatile matter, and fixed matter in sludge. It also describes the following laboratory procedures used to control the activated sludge process: suspended matter for mixed liquor and return sludge; settleability; sludge volume index; centrifuge method for estimating suspended matter; respiration rate; dissolved oxygen; biochemical oxygen demand; chloride; chlorine residual; chlorine requirement; ammonia nitrogen; nitrate nitrogen; total Kjeldahl nitrogen; total phosphorus; temperature; and specific gravity. Chapter 4 examines methods for determining coliforms and total fecal coliforms, and reviews basic microbiological sampling and testing procedures. Chapter 5 outlines data recording and reporting procedures for test results. (Geiger-PTT)
W87-06614

GUIDELINES FOR DEVELOPING A WASTEWATER SAFETY PROGRAM,
Water Pollution Control Federation, Washington, DC.
D. G. Campbell, R. J. Campbell, J. K. Esler, M. H. Marcus, and E. L. Niedringhaus.
Manual of Practice No. SM-2, Systems Management. Water Pollution Control Federation, Washington, DC. 1983. 44 p, 7 fig, 7 tab, 33 ref, append.

Descriptors: *Safety, *Management planning, *Project planning, *Training, *Wastewater treatment, Wastewater facilities, Inspection, Education, Personnel management, Accidents, Hazards, Evaluation, Maintenance, Design criteria.

A successful safety program incorporates a safety policy; safety inspections; safety training and promotion; and accident investigation and reporting, as well as provisions for a safe design. An example of a written safety policy for a wastewater treatment facility is presented along with suggestions for safety design and safety training of employees. Safety promotion should involve the formation of employee safety committees and the appointing of a safety officer. Methods for conducting an accident investigation are outlined. Safety inspections involve recognizing the hazards associated with specific tasks by performing job safety analyses. (Geiger-PTT)
W87-06615

EXISTING SEWER EVALUATION AND REHABILITATION.
American Society of Civil Engineers, New York.
ASCE-Manuals and Reports on Engineering Practice No. 62, WPCF-Manual of Practice FD-6. American Society of Civil Engineers, New York, New York. 1983. 106 p, 26 fig, 5 tab, 58 ref.

Descriptors: *Sanitary engineering, *Sewers, *Sewer systems, *Maintenance, Sewer infiltration, Monitoring, Flow measurement, Pipelines, Evaluation, Inspection, Wastewater collection, Performance evaluation, Design criteria, Safety, Structural engineering, Weirs, Hazards, Leakage.

This manual provides guidelines for the evaluation and rehabilitation of sanitary sewers. The initial chapter introduces the purpose and scope of sanitary sewer rehabilitation. Subsequent chapters provide sufficient detail and information so that users of the manual may understand, evaluate and institute a rehabilitation program. Topics covered include: evaluation of infiltration, inflow, and rainfall-induced inflow and infiltration; evaluation of physical conditions; flow measurement techniques; design of a system monitoring program, pipeline, manhole, and service connection rehabilitation; materials used for sewer rehabilitation; and methods to measure the effectiveness of sewer rehabilitation. Charts, figures, case studies, and illustrations are used where practical to reinforce the text. The major emphasis of the manual is on infiltration and inflow reduction with lesser emphasis being placed on maintaining the structural integrity of the sanitary sewer. Many of the rehabilitation methods presented are applicable for both aspects of sanitary sewer rehabilitation. The structural integrity aspects of sanitary sewer rehabilitation cannot be overemphasized because of the potentially destructive and costly events which often result after the collapse within the sewer system. (Geiger-PTT)
W87-06616

FINANCING AND CHARGES FOR WASTEWATER SYSTEMS: A SPECIAL PUBLICATION,
Water Pollution Control Federation, Washington, DC.
A. L. Anders, J. R. Brown, P. T. Carver, M. P. Daly, and C. B. Kaiser.
Second Edition. American Public Works Association, Chicago, Illinois. 1984. 129 p, 5 fig, 19 tab, 5 ref, 7 append.

Descriptors: *Cost allocation, *Wastewater treatment, *Financing, *Wastewater collection, *Economic aspects, Wastewater management, Wastewater facilities, Operating costs, Cost analysis, Cost repayment, Cost sharing, Sewer systems, Estimated costs, Accounting, Capital costs.

This manual provides a general overview of the current practices and procedures that should be considered for financing and charging for wastewater collection and treatment systems. The various arrangements used in the organization and administration of wastewater systems are discussed along with the financial management and accounting practices necessary for the successful operation of a wastewater utility. The factors involved in the financing of operating and capital costs are presented. Determination of the annual revenue requirements and responsibility for these costs are considered. The allocation of the costs of service to various specific cost-causation categories and customer classes is examined. The treatment of special service situations that often are encountered by wastewater utilities is illustrated. The designing of rates to recover costs in a way reflective of the cost-causative elements experienced by the wastewater utility is considered. The role of a professional consultant in assisting and preparing cost of service studies, contractual arrangements with larger customers, a philosophical statement of a utility's service obligations and responsibilities, and the impact of regulation on wastewater collection and treatment systems are discussed. (Geiger-PTT)
W87-06617

INDUSTRIAL WASTEWATER CONTROL PROGRAM FOR MUNICIPAL AGENCIES,
Water Pollution Control Federation, Washington, DC.
L. Abron-Robinson, J. D. Denit, F. M. Feldman, J. G. Kremer, and A. S. Lavin.
Manual of Practice No. OM-4, Operations and Maintenance. Water Pollution Control Federation, Washington, DC. 1982. 166 p, 42 fig, 23 tab, 83 ref.

Descriptors: *Industrial wastewater, *Industrial wastes, *Wastewater treatment, *Project planning, *Wastewater management, *Pollutant identification, Legal aspects, Effluent charges, Effluent limitations, Standards, Flow measurement, Safety Wastewater analysis, Sampling, Monitoring.

This manual provides guidance to municipal agencies that need to initiate or upgrade an industrial wastewater control program. It outlines the following basic requirements and activities for a successful municipal industrial waste regulatory program: developing a data base to characterize industrial discharges; preparing local ordinances; establishing limitations on industrial discharges to the treatment system and enforcing them; gaining authority to enter and inspect an industrial company and obtain samples of its wastewater discharges; developing monitoring and flow measurement programs to establish charges and gain insight into treatment requirements; and establishing a program to recover the cost of industrial waste treatment. Safety during inspections, monitoring, and treatment is considered. Treatment alternatives for industrial wastewaters are also examined. Appendices to the manual discuss EPA industrial categories and priority pollutants, and Freundlich parameters for selected organic priority pollutants. (Geiger-PTT)
W87-06618

SLUDGE DEWATERING,
Water Pollution Control Federation, Washington, DC.
D. Chaudhary, A. A. Costa, W. R. Elliott, R. C. Fedotoff, and Y. Hasit.
Manual of Practice No. 20. Water Pollution Control Federation, Washington, DC. 1983. 164 p, 64 fig, 30 tab, 149 ref.

Descriptors: *Dewatering, *Sludge drying, *Sludge thickening, *Separation techniques, *Filtration, Centrifugation, Wastewater treatment, Sludge conditioning, Sludge disposal, Design criteria, Sludge filters, Sludge solids, Vacuum filtration, Gravity filters, Screens, Osmosis.

This manual, which updates the Federation's 1969 manual of practice on the same subject, considers methods for integrating sludge dewatering processes into the overall treatment scheme and explores the impact on selection of dewatering devices by physical and chemical constituents of waste sludge; local, state, and federal regulations; and recycle streams. Results of pilot testing are presented and several sludge dewatering methods (land application, vacuum filtration, gravity and pressure filtration, and centrifugation) are discussed along with pertinent design criteria, performance data, cost determinants, and support processes. A sampling of emerging technologies (electroosmosis, cyclones, screens, and capillary suction) are also presented. The economics of sludge dewatering is examined only in a general sense; the need for site-specific data precludes a detailed evaluation of individual devices. (Geiger-PTT)
W87-06619

SEWER CHARGES FOR WASTEWATER COLLECTION AND TREATMENT - A SURVEY,
Water Pollution Control Federation, Washington, DC.
R. R. Rimkus, S. P. Graef, J. B. Coulter, T. E. McMahon, and C. S. Zickefoose.
Special Publication. Water Pollution Control Federation, Washington, DC. 1982. 46 p, 2 fig, 6 tab, append.

Descriptors: *Wastewater collection, *Wastewater treatment, *Capital costs, *Sewage rate, *Case studies, Sewer systems, Cost analysis, Operating costs, Maintenance costs, Financing, Surveys, Wastewater management.

This publication contains the tabulation of sewer charge methods used by various United States municipalities. Capital and operation and maintenance costs associated with the collection, treatment, and disposal of municipal wastewaters may be funded in the following ways: property taxes, general obligation bonds, revenue bonds, fees for services (domestic flows, commercial-industrial flows, permits and licenses, cesspool dumping, industrial waste, bonded sewers, capital investment, benefit district assessments, and connection and hook-ups), contracts with other agencies, fees or requirements placed on developers, interest income, revenues from other utilities or general funds, and short-term bank loans. Results of a survey taken in 66 cities are tabulated and include data on population, sewer service charges, equivalent monthly charges for a typical single-family residence, industrial waste charges, inspection fees, connection charges, and methods of financing capital costs. The development of service rate structure is examined for Los Angeles, California, Grand Rapids, Michigan, Galveston, Texas, and Orrville, Ohio. (Geiger-PTT)
W87-06620

WATER REUSE,
Water Pollution Control Federation, Washington, DC.
R. J. Avendt, D. Baumann, R. B. Baird, W. H. Bruvold, and W. J. Cooper.
Manual of Practice SM-3, Systems Management. Water Pollution Control Federation, Washington, DC. 1983. 118 p, 8 fig, 44 tab, 172 ref.

Descriptors: *Water reuse, *Wastewater renovation, *Recycling, *Wastewater treatment, *Public health, Monitoring, Wastewater management, Management planning, Social aspects, Legal aspects, Reclaimed water, Case studies, Water quality, Project planning.

This manual represents a collective effort to define the practice of water reuse by professionals actively involved in this field. Topics covered include: sources of wastewater for reuse; reuse applications; municipal treatment processes and systems; monitoring and control instrumentation; health effects; social, legal, and institutional aspects of reuse; and planning and management techniques. The chapter on sources of wastewater for reuse establishes the potential volumes and characteristics of water that may be reclaimed or recycled for beneficial reuse. Reuse applications are presented in terms of water quality requirements, potential and actual applications, case histories, and references. The range of relatively simple to complex reclamation systems necessary for reuse or recycle are presented. Monitoring and control instrumentation unique to water reuse are discussed in the context of monitoring requirements, control methods, and general instrumentation functions. In the majority of water reuse applications, successful implementation is contingent on social, legal, and institutional issues; these matters must be addressed at the earliest stages of developing a reuse program. The concluding chapter identifies planning and management methods for reuse projects based on experiences from previous water reuse programs. (Geiger-PTT)
W87-06621

5E. Ultimate Disposal Of Wastes

HEAVY METAL CONCENTRATIONS IN CATERPILLARS FED WITH WASTE-GROWN VEGETABLES,
Chinese Univ. of Hong Kong, Shatin. Dept. of Biology.
M. H. Wong, and Y. H. Cheung.
Agricultural Wstes AGWADL, Vol. 18, No. 1, p 61-68, 1986. 3 fig. 29 ref.

Descriptors: *Path of pollutants, *Waste disposal, *Land disposal, *Heavy metals, *Sludge disposal, *Food chains, *Bioaccumulation, *Vegetable crops, Lead, Copper, Zinc, Manganese.

If heavy metal-contaminated plants were consumed by animals, theoretically heavy metals would be transferred up the food chain. It has been suggested that the food chain could be contaminated unless stringent measures were taken to prevent it. Previous experiments have shown that flowering Chinese cabbage (Brasica parachinensis) and Chinese radish (Rhaphanus sativus) var. longipinnatus grown in soil amended with sewage sludge and animal manure accumulated Pb, Cu, Zn and Mn. In this experiment, caterpillars of the common white butterfly (Pieris canidia) were fed with the waste-grown vegetables. Caterpillars fed with sewage sludge-grown vegetables had a lower body weight and a higher level of heavy metals than those fed with animal manure-grown vegetables. Average fresh body weights of caterpillars fed with waste-grown leaves of Chinese radish were 75, 122, 186 and 196 mg for activated sludge, digested sludge, chicken manure, and pig manure, respectively. Those fed with flowering Chinese cabbage accumulated a higher level of heavy metals than those fed with Chinese radish; Pb 6.7-fold, Zn 6.8-fold, and Mn 5.7-fold in treatments with activated sludge. As a whole, the accumulation of heavy metals in the caterpillars, in descending order, was from vegetables manured with activated sludge, digested sludge, chicken manure, and pig manure. Caterpillars, even though ingesting an enormous amount of the leaves, accumulated a lower level of Pb, Cu, and Zn than that found in the vegetables. The route of elimination was not verified but it was suggested that the egestion of feces might play an important role. (Authors' abstract)
W87-05978

HEAVY METALS IN LANDFILL LEACHATE,
Geraghty and Miller, Inc., Hackensack, NJ.
For primary bibliographic entry see Field 5B.
W87-05988

ENVIRONMENTAL IMPACTS OF SEWAGE SLUDGE APPLIED TO CROPLAND,
National Inst. for Environmental Studies, Tsukuba (Japan).
T. Goda, T. Kuboi, and K. Fujii.
International Journal of Environmental Studies IJEVAW, Vol. 27, No. 3/4, p 239-253, 1986. 8 fig, 8 tab, 21 ref.

Descriptors: *Water pollution effects, *Waste disposal, *Sludge disposal, *Land disposal, Fertilizers, Soil properties, Plants, Agriculture, Nutrients, Groundwater.

At present, 15, 25, and 30 percent of sewage sludge is returned to the soil in Japan, U.S.A., and EC countries, respectively. Sludge application has two contrasting significances: (1) since the sewage sludge contains important elements (especially N and P) for plants, its application to land is essentially beneficial for crop production; and (2) sewage sludge is a possible source of potentially toxic elements and pathogenic microorganisms. Therefore, investigations oriented toward sludge application to obtain better crop yield without hazardous effects are appropriate. The National Institute for Environmental Studies, Japan, has pursued special research from 1978 to 1984 concerning the environmental effects due to land application of sewage sludge. In many cases, the repeated application of sewage sludge (more than 3-4 times), or a total application exceeding 30-50 tons/ha, caused (1) unfavorable soil pH (less than 6 or greater than 7.5), (2) decreased the numbers of soil microbes, (3) reduced crop yields, and (4) caused abnormal aymptoms in some kinds of crop. Ground water quality also changed unfavorably as nitrate concentrations exceeded the rate of sludge application. Soil water did not increase algal growth in the absence of PO4(3-) and chelates (EDTA). The application of sludge stimulated the formation of N2O. It seems that sewage sludge should not be applied more than three times nor at rates greater than 30 tons/ha. (Authors' abstract)
W87-05989

GROWTH OF DUCKWEED AND NUTRIENT REMOVAL IN A PADDY FIELD IRRIGATED WITH SEWAGE EFFLUENT,
Ehime Univ., Matsuyama (Japan). Dept. of Environment Conservation.
Z. Kawabata, R. Tatsukawa, and K. Sato.
International Journal of Environmental Studies IJEVAW, Vol. 27, No. 3/4, p 277-285, 1986. 2 fig, 2 tab, 11 ref.

Descriptors: *Wastewater treatment, *Water reuse, *Wastewater disposal, *Secondary wastewater, *Rice, *Duckweed, *Nutrient removal, Recycling, Impaired water use, Effluents.

Recycling sewage effluent as irrigation water for rice paddy fields may achieve two purposes: wastewater treatment, and re-utilization of water. Rice paddy fields teem with various planktonic and aquatic plants, indicating a high rate of metabolic activity. There is also a high rate of transformation of organic and inorganic substances as well, suggesting the possibility of using the paddy field as a natural sewage treatment plant. It is important to determine whether the use of secondary treated sewage for irrigation water is harmful to the rice plants. The biomass of duckweed, water quality and rice production were surveyed in two paddy fields; one irrigated with secondary treated sewage effluent, and the other with river water. Chemical analyses were also carried out on the sewage effluent and river water in order to evaluate the role of duckweed in a paddy field. It was concluded that duckweed growth played a beneficial role as a mitigating agent on excessive nutrient supply to rice plants as well as a purifier of the sewage effluent. (Authors' abstract)
W87-05991

GENES FOUND TO HELP BACTERIA 'EAT' PESTICIDES,
Science and Education Administration, Beltsville, MD. Pesticide Degradation Lab.
For primary bibliographic entry see Field 5D.
W87-06018

LEVELS OF NINE POTENTIALLY TOXIC ELEMENTS IN IDAHO FISH MANURES,
Idaho Univ., Moscow. Washington Animal Disease Diagnostic Lab.

For primary bibliographic entry see Field 5A.
W87-06031

PROTECTION OF GROUNDWATER BY IMMOBILIZATION OF HEAVY METALS IN INDUSTRIAL WASTE IMPACTED SOIL SYSTEMS,
Utah Water Research Lab., Logan.
J. E. McLean, L. M. Dudley, and R. C. Sims.
Available from the National Technical Information Service, Springfield, VA 22161 as PB87 112413/AS, Price codes: A05 in paper copy, A01 in microfiche. Program Report G936-06, September 1986. 67 p, 16 fig, 23 tab, 39 ref. Contract No. 14-08-0001-G936, Project No. USGS G936-06.

Descriptors: *Heavy metals, *Groundwater pollution, *Leaching, *Waste treatment, *Land disposal, *Soil amendment, Sorption, Desorption, Kinetics, Hazardous wastes, Water pollution sources, Pollutant identification, Separation techniques.

Immobilization processes in soil/waste systems impacted by hazardous wastes containing heavy metals were investigated. Samples of contaminated material (soil and/or waste) from nine sites in the Intermountain West and California included milling, electroplating, cement kiln dust, petroleum, and tailing and waste rock from mining operations. A sequential extraction procedure, originally developed to fractionate metals in sludge amended soils into water soluble, mobile, and plant available forms, was used to obtain preliminary identification of the leachable metal fraction for the hazardous waste contaminated soils studied. The potassium nitrate and water fractions defined the potentially leachable metals in the wastes. Samples with metal concentrations greater than drinking water limits in these fractions were identified as most likely to present a groundwater pollution problem. Sorption kinetics and batch sorption/desorption studies were performed to determine the interaction of Cu and Cd, from an acidic leachate of a mine waste, with calcareous soils. Solid phase diagrams, exchange models and GEOCHEM were used to define the mechanisms of metal attenuation of these soils. Results indicate that exchange reactions were the dominant solid phase in controlling cationic metal soil solution concentrations when carbonate minerals in the soil were depleted with the addition of the acidic leachate. When sufficient CaCO3 was present, Cu and Cd were specifically adsorbed on the surface of the carbonate minerals. Precipitation occurred only at the higher levels of metal addition. Desorption studies indicated a potential for release of sorbed metals with leaching solutions. (Hrezo-VPI)
W87-06079

WASTEWATER USE FOR IRRIGATION: A CASE HISTORY IN HAWAII,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 3C.
W87-06121

EFFLUENT IRRIGATION OF CALIFORNIA-GRASS: N BUDGET AND CROP YIELDS,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 3C.
W87-06123

WASTEWATER IRRIGATION FOR BIOMASS PRODUCTION AND NITROGEN REMOVAL,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 3C.
W87-06125

RESEARCH NEEDS ON DISPOSAL OF WASTEWATER,
Engineering-Science, Inc., Austin, TX.
D. L. Ford.
IN: Water Resources in Texas: The Need for a Water Research Agenda. Water Resources Symposium Number Eleven. University of Texas at Austin. Center for Research in Water Resources, 1984. p 191-211, 4 fig, 4 tab, 10 ref.

Descriptors: *Wastewater disposal, *Research priorities, *Wastewater management, Water quality control, Hazardous wastes, Industrial wastes, Deep wells, Ocean dumping, Groundwater pollution.

The purpose of this study is to first narrow the problem areas and research needs to selected topics of wastewater disposal, then expand these defined categories in terms of implementation, control, and research. Specifically, the generation of potentially hazardous wastes concomitant with industrial growth and their disposal with minimal environmental impact are discussed. The concepts of deep well and ocean disposal of selected industrial wastes are presented, concurrently considering the state of the art of this disposal technology, what the alternative impacts might be, and the research needs for these disposal methodologies. Groundwater contamination and possible remedial activities are also discussed. (See W87-06144) (Lantz-PTT)
W87-06157

BIOASSESSMENT METHODOLOGIES FOR THE REGULATORY TESTING OF FRESHWATER DREDGED MATERIAL, PROCEEDINGS OF A WORKSHOP.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5A.
W87-06200

LAND DISPOSAL OF SEWAGE EFFLUENTS AND RESIDUES,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
J. C. Lance.
IN: Groundwater Pollution Microbiology, John Wiley and Sons, New York, New York, 1984. p 197-224, 2 fig, 4 tab, 93 ref.

Descriptors: *Land disposal, *Water pollution sources, *Path of pollutants, *Groundwater pollution, Municipal wastes, Wastewater treatment, Heavy metals, Nitrogen, Trace organics.

Land application can be an economical and effective way to utilize municipal wastes if land treatment systems and management pratices are carefully designed to avoid contamination of water resources and food supplies. Relatively thin layers of soils remove bacteria primarily by straining and viruses by adsorption. Exceptions are very coarse sands and gravels that have very high infiltration rates and may allow direct channeling to the groundwater. The most important soil characteristic affecting pathogen removal by soils seems to be soil permeability. The pathogen removal capacity of a soil can be changed by changing soil permeability and perhaps other alterations. More research is needed to understand basic pathogen-soil interactions and to develop methods to increase pathogen removal capacity of soils. Contamination of groundwater by nutrients can be prevented if the capacity of land treatment systems to assimilate nitrogen is not exceeded. Movement of heavy metals in soils is quite limited, but quantitites of metals applied to soils must be restricted to limit soil enrichment and subsequent crop contamination. In arid areas, irrigation of land treatment systems must be managed to minimize salt movement to groundwater by enhancing the precipitation of salts in the vadose zone. The movement of trace organics in land treatment systems is minimal except in high-rate land filtration systems. More research is needed on the movement and degradation of trace organics in soils. (See also W87-06201) (Lantz-PTT)
W87-06210

MATHEMATICAL MODELS OF THE DISCHARGE OF WASTEWATER INTO A MARINE ENVIRONMENT,
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W87-06224

REMOVAL OF METALS FROM WASTEWATER: NEUTRALIZATION AND PRECIPITATION.
For primary bibliographic entry see Field 5D.
W87-06232

GROUND WATER AND UNDERGROUND TANKS: PAST PROBLEMS AND PRESENT SOLUTIONS,
ICF, Inc., Washington, DC.
D. H. Bauer, and C. D. Wolfe.
IN: Options for Reaching Water Quality Goals, Proceedings of the Twentieth Annual Conference of the American Water Resources Association Symposium, Washington, DC., August 15, 1984. 1985. p 185-188, 3 ref.

Descriptors: *Groundwater pollution, *Water pollution control, *Underground storage, *Waste disposal, *Storage tanks, Hazardous wastes, Leakage, Monitoring, Economic aspects.

Hazardous wastes are stored using a variety of methods including surface impoundments, tanks and containers. Hazardous materials ranging from gasoline to industrial chemicals are generally stored in tanks and containers. Examples of hazardous wastes mismanagement resulting in costly and damaging consequences have been extensively publicized, and to a lesser extent problems associated with hazardous materials have also been documented. Since underground tank systems have historically not included provisions for leak detection (except to the extent that higher than normal production costs lead plant personnel to suspect product losses), leaks may continue undetected for years. When finally detected, leak consequences may range from minimal soil contamination to multi-million dollar groundwater cleanup problems. Both technical and administrative mechanisms for addressing the risk of groundwater contamination posed by underground tank storage of hazardous materials and wastes are discussed. Technical options include approaches applicable to both existing tank systems and new construction. Effectiveness of several options in controlling release (leaks and ruptures) and the associated costs are discussed. From an administrative standpoint, improvement of historical underground tank storage practices may be achieved through regulation at any of several levels (local, state or federal) and through changes in corporate policies without regulation. Current administrative activities designed to address the problem and some additional options are presented. (See also W87-06270) (Author's abstract)
W87-06289

CONTROLLING GROUND WATER POLLUTION FROM SEWAGE EFFLUENT DISPOSAL IN THE TUCSON AREA,
Pima County Dept. of Wastewater Management, Tucson, AZ.
For primary bibliographic entry see Field 5G.
W87-06290

CHARACTERIZATION OF CHEMICAL WASTE SITE CONTAMINATION AND DETERMINATION OF ITS EXTENT USING BIOASSAYS,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5A.
W87-06322

TOTAL MERCURY IN MARINE SEDIMENTS NEAR A SEWAGE OUTFALL. RELATION WITH ORGANIC MATTER,
Instituto Nacional de Investigacion y Desarrollo Pesquero, Mar del Plata (Argentina).
For primary bibliographic entry see Field 5B.
W87-06367

RARE EARTH ELEMENT CONTENT OF SEWAGE SLUDGES DUMPED AT SEA IN LIVERPOOL BAY, U.K.,
Lancaster Univ., Bailrigg (England). Lancashire and Western Sea Fisheries Joint Committee.

C. M. G. Vivian.
Environmental Technology Letters ETLEDB, Vol. 7, No. 11, p a593-596, November 1986. 2 tab, 7 ref.

Descriptors: *Waste disposal, *Water pollution sources, *Liverpool Bay, *Ocean disposal, *Rare earth elements, *Sludge disposal, United Kingdom, Chemical analysis.

The concentrations of 12 rare earth elements (REEs) (La, Ce, Pr, Nd, Sm, Eu, Gd, Dy, Ho, Er, Yb, Lu) were determined in 4 sewage sludges that are dumped at sea in Liverpool Bay, United Kingdom. High concentration of La, Pr, Nd, and Sm were found in the Warrington sludge, probably deriving from the glassmaking industry. The concentrations of REEs in the Davyhulme and Salford sludges generally were well within, and in the Runcorn sludge was at the bottom of, the data reported in the literature. (Author's abstract)
W87-06372

INVESTIGATIONS INTO THE FACTORS INFLUENCING LONG RANGE MATRIX DIFFUSION RATES AND PORE SPACE ACCESSIBILITY AT DEPTH IN GRANITE,
UKAEA Atomic Energy Research Establishment, Harwell (England). Chemistry Div.
M. H. Bradbury, and A. Green.
Journal of Hydrology JHYDA7, Vol. 89, No. 1/2, p 123-139, December, 1986. 9 fig, 2 tab, 20 ref.

Descriptors: *Groundwater movement, *Path of pollutants, *Radioactive waste disposal, *Crystalline rocks, *Rock properties, *Diffusion, *Colloids, Rock testing, Pressure, Granite, Water transport.

Investigations in granite systems were conducted on (1) diffusion through fissure surfaces, (2) the effect of confining pressures on diffusion rates, (3) the extent of pore interconnectivity over meter-distances, and (4) the accessibility of the pore space to colloidal particles in the size range 0.3-0.09 micron. Diffusion rates through fissure surfaces were greater than or equal to those measured on samples taken well away from such surfaces. No evidence for pore blocking by alteration products was found. Confining pressures of up to 16 MPa reduced diffusion rates. At the higher pressures, reductions by factors of between 2 and 2.5 compared with diffusion rates measured at ambient pressure were recorded. Pore connectivity over distances of up to 125 cm on granite cores saturated with 3 M NaCl was demonstrated by measurement of formation factors as a function of core length using a conductivity technique. Increases in the formation factor for short core lengths (about 1 cm) were ascribed to sample size and pore geometry effects, which converted some of the dead-end porosity into transport porosity. Colloidal particles in the size range investigated neither entered the pore structure nor blocked pore apertures to any significant extent. (Author's abstract)
W87-06383

ACCUMULATION OF CADMIUM, MERCURY, AND LEAD BY VEGETABLES FOLLOWING LONG-TERM LAND APPLICATION OF WASTEWATER,
Tehran Univ. (Iran). School of Pharmacy.
For primary bibliographic entry see Field 5B.
W87-06389

TOXICOLOGICAL EVALUATION OF THE LEACHATE FROM A CLOSED URBAN LANDFILL,
North Dakota State Univ., Fargo. Dept. of Pharmacognosy.
For primary bibliographic entry see Field 5C.
W87-06428

COMPILATION OF HYDROLOGIC DATA FROM DRILLING THE SALADO AND CASTILE FORMATIONS NEAR THE WASTE ISOLATION PILOT PLANT (WIPP) SITE IN SOUTHEASTERN NEW MEXICO,
Sandia National Labs., Albuquerque, NM.
For primary bibliographic entry see Field 7C.
W87-06452

HYDRAULIC-TEST INTERPRETATIONS FOR WELL DOE-2 AT THE WASTE ISOLATION PILOT PLANT (WIPP) SITE,
Sandia National Labs., Albuquerque, NM. Earth Sciences Div.
For primary bibliographic entry see Field 7C.
W87-06453

HEAVY METAL CONCENTRATION IN SLUDGE-SOIL SYSTEMS AS A RESULT OF WATER INFILTRATION,
Puerto Rico Univ., Mayaguez. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5B.
W87-06460

LANDFILL TECHNOLOGY,
J. F. Crawford, and P. G. Smith.
Butterworths, London, England. 1985. 159 p, 54 fig, 12 tab, 18 ref.

Descriptors: *Waste disposal, *Landfills, *Waste management, *England, Waste dumps, Leachates, Groundwater pollution, Rehabilitation, Water pollution.

Waste disposal by landfill has been practiced for many years, but the technology of landfill has only started to develop in the last decade. Landfill used to be an art; it is now developing into a science. The current state of theory and practice is described including each of the stages involved in opening, running and closing a site. It covers site selection; preparation and operation; the biochemistry of landfills; gas production; leachate quantities and qualities; pollution of surface and groundwater by leachates; leachate treatment; and landfill rehabilitation. (Lantz-PTT)
W87-06519

SLUDGE STABILIZATION,
Water Pollution Control Federation, Washington, DC.
For primary bibliographic entry see Field 5D.
W87-06609

SLUDGE DEWATERING,
Water Pollution Control Federation, Washington, DC.
For primary bibliographic entry see Field 5D.
W87-06619

5F. Water Treatment and Quality Alteration

LEGIONELLA PNEUMOPHILA IN A METROPOLITAN WATER DISTRIBUTION SYSTEM,
Ohio State Univ., Columbus. Dept. of Microbiology.
For primary bibliographic entry see Field 5A.
W87-05923

CAN POLYETHYLENE PIPES IMPART ODORS IN DRINKING WATER,
Centre de Recherche Lyonnaise des Eaux - Degremont, Le Pecq (France).
C. Anselme, K. N'Guyen, A. Bruchet, and J. Mallevialle.
Environmental Technology Letters ETLEDB, Vol. 6, No. 11, p 477-488, November 1985. 5 fig, 6 tab, 15 ref.

Descriptors: *Pipelines, *water quality, *Water pollution sources, *Odors, *Drinking water, *Polyethylene, Organic compounds, Water distribution, Alkylphenols, Aldehydes, Ketones, Construction materials.

A case study is reported that demonstrates the appearance of numerous organic compounds associated with intense taste and odor problems during the passage of a drinking water through a 300 m polyethylene pipe. Batch experiments showed that two principal mechanisms are involved in the occurrence of organoleptic changes caused by defective polyethylene tubings: dissolution of polymer additives (eg, alkylphenols) and oxidation of the internal surface of the pipe during extrusion with subsequent release of the resulting polar compounds (eg, aldehydes, ketones). Twenty percent of the pipes tested (n = 264) appeared to be defective and the total release time may exceed several months under low flow rate conditions. (Author's abstract)
W87-05926

MODE OF ACTION OF CHLORINE DIOXIDE WITH CERTAIN NITROGENOUS COMPOUNDS IN AN AQUEOUS MEDIUM (MODE D'ACTION DU BIOXYDE DE CHLORE SUR QUELQUES COMPOSES ORGANIQUES AZOTES EU MILEU AQUEUX DILUE),
Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
H. Ben Amor, J. de Laat, and M. Dore.
Environmental Technology Letters ETLEDB, Vol. 6, No. 11, p 489-504, November 1985. 8 fig, 6 tab, 22 ref.

Descriptors: *Chlorine dioxide, *Organic compounds, *Chemical reactions, *Water pollution sources, *Chlorination, *Water treatment, Chlorites, Chlorides, Chlorates, Nitrogen compounds, Oxidation.

Chlorine dioxide reacts very rapidly with aromatic amines, with nitrophenols, and with pyrrole, whereas nitrobenzene, pyridine, and primary aliphatic amines do not react at all. With reactive organic compounds, oxidation can lead to important production of paraquinone as an end product from 4-aminophenol (1 mole/mole), from NN-substituted aniline (0.5 mole/mole), and from aniline (0.1-0.2 mole/mole). With certain nitrogenous compounds, products from opening aromatic rings (eg, carbon dioxide and maleic and oxalic acids) also were identified. Significant production of ammonia and of nitrates (0.4-1.0 mole/mole) was measured, the former from aromatic amines, the latter from nitrophenols. The analyses of chlorinated entities indicate production of various chlorinated organic compounds and of inorganic entities (chlorites, chlorides, and chlorates). (Author's abstract)
W87-05927

OZONATION OF AQUATIC ORGANIC MATTER AND HUMIC SUBSTANCES: AN ANALYSIS OF SURROGATE PARAMETERS FOR PREDICTING EFFECTS ON TRIHALOMETHANE FORMATION POTENTIAL,
Arizona Univ., Tucson. Dept. of Civil Engineering and Engineering Mechanics.
G. L. Amy, P. A. Chadik, R. A. Sierka, and W. J. Cooper.
Environmental Technology Letters ETLEDB, Vol. 7, No. 2, p 99-108, February 1986. 5 fig, 3 tab, 23 ref. EPA Grant R809935-01.

Descriptors: *Ozonation, *Water pollution sources, *Organic matter, *Humic substances, *Trihalomethane control, *Water treatment, Surrogate parameters, Oxidation, Chlorination, Fluorescence, Non-volatile total organic carbon, Water analysis.

Research was conducted to (1) compare the general response of organic matter and humic substances present in a wide range of natural and synthetic waters to ozonation applied for trihalomethane (THM) control and (2) evaluate the potential use of several surrogate parameters for monitoring the effects of ozonation on THM formation potential (THMFP). Partial oxidation of THM precursors by ozone yielded by-products that were less reactive in THMs upon chlorination. Aquatic organic matter and humic substances vary in their amenability toward ozonation for THM control. There appears to be both a fraction of THM precursors amenable to ozone destruction and an 'ozone-refractory' fraction. For the range of water sources and applied ozone doses studied here, 168-hr THMFP reductions ranged from as little as 1% to

as high as 68%. Both fluorescence and nonvolatile total organic carbon (NVTOC) demonstrated potential as nonspecific surrogate parameters for predicting THMFP, but a multiplicative term, the product of UV absorbance and NVTOC, proved to be the most accurate. (Rochester-PTT)
W87-05943

REMOVAL OF ORGANIC ACIDS BY ACTIVATED ALUMINA GAMMA-AL2O3 IN AN AQUEOUS MEDIUM. COMPARISON WITH AN ACTIVATED CARBON (MODE D'ELIMINATION DE COMPOSES ORGANIQUES POLAIRES PAR UNE ALUMINE ACTIVEE GAMMA-AL2O3 EN MILIEU AQUEUX. COMPARAISON AVEC LE CHARBON ACTIF),
Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
F. Bouanga, J. de Laat, and M. Dore.
Environmental Technology Letters ETLEDB, Vol. 7, No. 4, p 239-254, April 1986. 12 fig, 5 tab, 13 ref.

Descriptors: *Organic acids, *Adsorption, *Water treatment, *Humic acids, *Activated alumina, *Activated carbon, *Hydrogen ion concentration, Anions, Organic matter, Sodium hydroxide, Bacteria, Filtration, Solutes, Comparison studies.

Batch experiments carried out on dilute solutions of organic acids (oxalic, maleic, benzoic and salicylic acids, and humic substances) showed that activated alumina, gamma-Al2O3, removed these solutes from the water. The removal of organic acids was optimum in an acid medium ($4 < pH < 6$) and was significantly affected by the presence of inorganic anions. Filtration experiments showed competitive fixation of organic acids on gamma-A2O3. Activated alumina could be regenerated by sodium hydroxide solutions, but an important loss of efficiency of the filters was observed for salicylic acid removal during five exhaustion-regeneration cycles. A comparative study showed clearly that granular activated carbon (F400) had higher adsorptive capacities and was a better support for bacterial growth than activated alumina gamma-A2O3. (Author's abstract)
W87-05948

ELIMINATION OF CHLORINATED SOLVENTS IN WATER: METHODOLOGY OF SIZING OF COUNTER-CURRENT PACKED TOWERS (ELIMINATION DES SOLVANTS CHLORES DE L'EAU: METHODOLOGIE DE DIMENSIONNEMENT DES COLONNES A GARNISSAGES A CONTRE-COURANT),
Institut National des Sciences Appliquees de Lyon, Villeurbanne (France). Lab. de Chimie et Genie de l'Environnement.
M. Roustan, N. Ganne, G. Faucher, and E. Brodard.
Environmental Technology Letters ETLEDB, Vol. 7, No. 5, p 273-282, May 1986. 2 fig, 6 tab, 13 ref.

Descriptors: *Chlorinated solvents, *Groundwater pollution, *Water treatment, *Counter-current packed towers, *Design standards, Trichloroethylene, Chloroform, Cost analysis.

A method is presented for the design of counter-current packed towers for removal of chlorinated solvents from groundwater (e.g., trichloroethylene, chloroform). The influence of column height, diameter, and the stripping factor R on performance are discussed. The value R is very important and must be optimized. An optimal value of R can be found by taking into account packing volume and total power displaced for liquid pumping and aeration, which corresponds to operating costs. (Rochester-PTT)
W87-05951

INVESTIGATION OF HYDROXAMIC ACIDS FOR THE EXTRACTION OF CHROMIUM(III) FROM LEATHER WASTE AND THE POSSIBLE RE-USE OF THE EXTRACTED CHROMIUM IN THE TANNING INDUSTRY,
University Coll., Dublin (Ireland). Dept. of Chemistry.
For primary bibliographic entry see Field 5D.
W87-05952

CHLORINATION OF FATTY ACIDS DURING WATER TREATMENT DISINFECTION: REACTIVITY AND PRODUCT IDENTIFICATION,
Water Research Centre, Marlow (England).
T. M. Gibson, J. Haley, M. Righton, and C. D. Watts.
Environmental Technology Letters ETLEDB, Vol. 7, No. 7, p 365-372, July 1986. 3 fig, 2 tab, 13 ref.

Descriptors: *Water treatment, *Pollution identification, *Chlorination, *Disinfection, *Fatty acids, *Mass spectrometry, Molecular weight, Chemical reactions.

A series of fatty acids were subjected to conditions typical of water chlorination disinfection. Saturated fatty acids did not react with chlorine, but unsaturated fatty acids were consumed almost completely after 1 hr. A number of chlorinated and oxygenated products of this reaction were tentatively identified using fast atom bombardment mass spectrometry (FAB-MS). Of the products formed the chlorohydroxy derivative of hexadec-9-enoic acid was amenable to analysis by gas chromatography but the dichlorodihydroxy derivative of octadec-9,12-dienoic acid was not. Negative ion FAB-MS is a useful tool for obtaining molecular weight information from fatty acids and some of their derivatives. (Rochester-PTT)
W87-05957

COMPARISON OF REVERSE OSMOSIS AND ELECTRODIALYSIS FOR REMOVAL OF NITRATE FROM GROUNDWATER (PROZESSVERGLEICH VON UMKEHROSMOSE UND ELEKTRODIALYSE AM BEISPIEL DER NITRAT-ENTFERNUNG AUS GRUNDWAESSERN),
Technische Hochschule Aachen (Germany, F.R.). Inst. fuer Verfahrenstechnik.
For primary bibliographic entry see Field 3A.
W87-06011

REVIEW OF THE ISRAELI TECHNICAL COMMITTEE FOR ASBESTOS,
Tel-Aviv Univ. (Israel). Research Inst. for Environmental Health.
For primary bibliographic entry see Field 5G.
W87-06015

DRINKING-WATER AND SANITATION: A VILLAGE IN ACTION,
Ban Phai District Hospital (Thailand).
For primary bibliographic entry see Field 5G.
W87-06016

OCCURRENCE AND BIOLOGICAL ACTIVITY TESTING OF PARTICULATES IN DRINKING WATER,
McCrone Environmental Services, Inc., Norcross, GA.
J. R. Millette, P. J. Clark, R. L. Boone, and M. T. Rosenthal.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 1, p 1-8, January 1987. 1 fig, 1 tab, 16 ref.

Descriptors: *Drinking water, *Water analysis, *Particulate matter, *Biological properties, *Suspended solids, *Turbidity, *Electron microscopy, Monitoring, Water treatment facilities, Microscopy, Asbestos, Surveys, Public health.

Drinking water samples collected by local water utilities were tested by electron microscopy for asbestos and other particles contributing to turbidity. The asbestos type found most frequently was chrysotile. Significant numbers of attapulgite fibers (palygorskite clay) and some halloysite clay fibers were found in some systems. Fibers of biological origin were also found. Analyses of more than 2,000 samples from many parts of the United States suggest that, while some drinking waters do contain large quantities of particulates, most water consumers do not drink water containing large numbers of elongated mineral particulates having lengths three times the diameter. (Doria-PTT)
W87-06021

MECHANISM OF CHLORAMINE INACTIVATION OF POLIOVIRUS: A CONCERN FOR REGULATORS,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 5B.
W87-06124

PROBLEMS AND RESEARCH NEEDS WITH SAFE REUSE OF WATER,
Illinois Univ. at Urbana-Champaign. Inst. for Environmental Studies.
For primary bibliographic entry see Field 3C.
W87-06154

NEW METHOD TO DISSOLVE OZONE IN WATER: DEEP U TUBE,
Centre de Recherche Lyonnaise des Eaux - Degremont, Le Pecq (France).
E. Brodard, J. P. Duguet, J. Mallevialle, and M. Roustan.
Environmental Technology Letters ETLEDB, Vol. 7, No. 9, p 469-478, September 1986. 7 fig, 4 tab, 17 ref.

Descriptors: *Water treatment, *Deep U tube, *Ozonation, *Dissolved gases, Disinfection, Virucides, Bactericides, Organic matter, Water treatment facilities, Ozone, Turbulence, Pressure, Performance evaluation.

The deep U tube (DUT), its operational characteristics, and the results of performance studies with the DUT are described. The DUT works under pressure, creating turbulence, and is very efficient for transfer of a gas like ozone into a liquid. The DUT gives better ozone transfer than conventional devices at a comparable level of energy consumption. Because the DUT is based on a plug flow mechanism, it can be equally efficient with shorter contact times. Conventional ozonation columns and U-tubes were compared on a pilot plant scale in terms of dissolution efficiencies and chemical and biological parameters of the water receiving ozone treatment. The DUT has bactericidal and virucidal effects comparable to those in the classical ozone contactor and offers substantial improvements in the oxidation of organics. (Rochester-PTT)
W87-06365

MIXED ADSORBENTS FOR CU(II) REMOVAL FROM AQUEOUS SOLUTIONS,
Banaras Hindu Univ., Varanasi (India). Inst. of Tech.
K. K. Panday, G. Prasad, and V. N. Singh.
Environmental Technology Letters ETLEDB, Vol. 7, No. 10, p 547-554, October 1986. 7 fig, 2 tab, 22 ref.

Descriptors: *Wastewater treatment, *Water treatment, *Adsorbents, *Copper, *Clays, Fly ash, Wollastonite, Hydrogen ion concentration, Desorption, Cost analysis, Metal complexes, Freudlich equation.

Low-cost mixed adsorbents were used to study the removal of Cu(II) from aqueous solutions of different concentrations and pH. The uptake of Cu(II) was maximum with wollastonite-china clay, followed by fly ash-wollastonite and fly-ash china clay at the same concentration, temperature, and pH. Equilibrium data of various systems at 30 C and pH 6.5 fit well in the Freundlich equation. Removal of Cu(II) increases with the pH of the solution and is maximum at pH 8.0. Significant desorption of Cu(II) from the surfaces of mixed adsorbents was noted at pH 2.0. (Author's abstract)
W87-06370

RECOVERY, RECYCLE AND REUSE OF INDUSTRIAL WASTES,

Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5D. W87-06445

WATER TREATMENT SPECIFICATION MANUAL,
Metropolitan Refining Co., Long Island City, NY.
F. Rosa.
McGraw-Hill Book Company, New York, New York. 1985. 207 p, 77 fig, 15 ref.

Descriptors: *Water treatment, *Standards, *Manuals, Algaecides, Recirculating water systems, Chemical treatment, Biological treatment.

The objective of this book is to provide consulting firms, professional engineers, mechanical contractors and direct clients with the means for solving water treatment problems, while at the same time using minimal chemistry to illustrate its points. Up till now, design engineers wanting sets of specs and drawings for projects requiring water treatment had to utilize sets already existing, altering them to meet the new conditions. The engineers may have also contacted water treatment firms to supply specifications for the proposed projects, which guidelines probably were very specific and tended to limit the engineers to the use of particular programs and at times unique chemical feed equipment unavailable elsewhere. But with the help of this book design engineers can specify nonproprietary water treatment programs for clients and feel confident, if the specs are met, that the clients will be pleased. The drawings used to illustrate the manual, based on extensive field experience, try to eliminate those water treatment call-back problems that can sour engineer-client relationships. Problems such as a fouled closed recirculating water system, bacterial activity in open recirculating systems, boiler flooding, and choosing from among the multiplicity of 'chemical soups' on the market are discussed. (Lantz-PTT)
W87-06447

ANALYTICAL ASPECTS OF OZONE TREATMENT OF WATER AND WASTEWATER.
For primary bibliographic entry see Field 5D. W87-06492

APPLICATIONS OF OZONE IN WATER AND WASTEWATER TREATMENT,
Rice International Consulting Enterprises, Aston, MD.
For primary bibliographic entry see Field 5D. W87-06493

REQUIREMENTS FOR ANALYTICAL PROCEDURES AND METHODOLOGIES IN THE OZONE TREATMENT OF WATERS AND WASTEWATERS,
Rice International Consulting Enterprises, Aston, MD.
For primary bibliographic entry see Field 5D. W87-06494

INTRODUCTION TO THE CHEMICAL REACTIONS OF OZONE PERTINENT TO ITS ANALYSIS,
Miami Univ., Oxford, OH. Dept. of Chemistry.
For primary bibliographic entry see Field 5D. W87-06495

METHODS OF DETERMINATION OF OZONE IN AIR AND IN WATER,
Societe Degremont, Rueil-Malmaison (France).
For primary bibliographic entry see Field 5D. W87-06496

ANALYSIS OF OZONE IN AQUEOUS SOLUTION,
North Carolina Univ. at Chapel Hill.
For primary bibliographic entry see Field 5D. W87-06497

DETAILED COMPARISON OF ANALYTICAL METHODS FOR RESIDUAL OZONE MEASUREMENT,
Miami Univ., Oxford, OH. Dept. of Chemistry.
For primary bibliographic entry see Field 5D. W87-06498

ANALYSIS OF OZONE IN AQUEOUS SOLUTIONS USING A MODIFIED IODOMETRIC TECHNIQUE WITH AS(III),
Vanderbilt Univ., Nashville, TN. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5D. W87-06499

DETERMINATION OF OZONE AND CHLORINE DIOXIDE IN WATER BY THE INDIGO METHOD,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
For primary bibliographic entry see Field 5D. W87-06500

DETERMINATION OF OZONE IN WATER BY THE INDIGO METHOD; A SUBMITTED STANDARD METHOD,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
For primary bibliographic entry see Field 5D. W87-06501

MEASUREMENT OF RESIDUAL OZONE IN WATER - SPECIFICITY AND AUTOMATION,
Compagnie Intercommunale Bruxelloise des Eaux (Belgium).
For primary bibliographic entry see Field 5D. W87-06502

TECHNIQUE OF CONTINUOUS ELECTROCHEMICAL MEASUREMENT OF RESIDUAL ACTIVE OXIDANTS (RAO) IN WATERS,
Compagnie Intercommunale Bruxelloise des Eaux (Belgium).
For primary bibliographic entry see Field 5D. W87-06503

MEASUREMENT AND REGULATION OF OZONE IN THE PRESENCE OF CHLORINE,
Societe Degremont, Rueil-Malmaison (France).
For primary bibliographic entry see Field 5D. W87-06504

DETERMINATION OF RESIDUAL OZONE IN WATER AND MIXTURES OF OZONE WITH FREE AND COMBINED CHLORINE, CHLORIDE DIOXIDE, AND CHLORITE,
For primary bibliographic entry see Field 5D. W87-06505

PHOTOMETRIC DETERMINATION OF OZONE AT LOW CONCENTRATIONS WITH DIETHYL-P-PHENYLENEDIAMINE,
Miami Univ., Oxford, OH. Dept. of Chemistry.
For primary bibliographic entry see Field 5D. W87-06506

OZONE MEASUREMENT IN WATER TREATMENT PLANTS: COMPARISON OF THE DPD AND INDIGO METHODS,
Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Radiochemie.
E. Gilbert, and J. Hoigne.
IN: Analytical Aspects of Ozone Treatment of Water and Wastewater, Lewis Publishers, Chelsea, Michigan. 1986. p 245-255, 9 tab, 10 ref.

Descriptors: *Water treatment, *Water treatment facilities, *Ozone, *Water quality control, *Chemical analysis, *DPD method, *Indigo method, Photometry, Ozonation, Drinking water, Manganese, Indigo trisulfonate.

The indirect photometric determination of low ozone concentrations in water using the DPD method (diethyl-p-phenylenediamine reagent) was tested and compared with the indigo method (indigo trisulfonate reagent) during workshops at five water treatment plants. Ozone determinations in the range 0.02 to 1.2 mg/L were performed using waters of varying quality (lake water, groundwater, manganese-containing groundwater, etc.). Both methods were easy to perform and gave consistent results for all the drinking waters when appropriate procedures were used for waters of high manganese content. The advantages and disadvantages of the two methods are compared. (See also W87-06492) (Author's abstract)
W87-06507

EVALUATION OF ANALYTICAL METHODS FOR DISSOLVED OZONE IN NATURAL WATERS AND WASTEWATER,
North Carolina Univ. at Chapel Hill.
For primary bibliographic entry see Field 5D. W87-06508

EXAMPLE OF AUTOMATIC REGULATION OF OZONE PRODUCTION - THE PLANT AT NANTES LA ROCHE (FRANCE),
For primary bibliographic entry see Field 5D. W87-06514

CONTROL OF A FULLY AUTOMATED OZONE APPLICATION SYSTEM,
Hankin Environmental Systems, Scarborough (Ontario).
D. R. MacKay.
IN: Analytical Aspects of Ozone Treatment of Water and Wastewater, Lewis Publishers, Chelsea, Michigan. 1986. p 375-381, 5 fig.

Descriptors: *Water treatment, *Ozone, *Automation, *Water quality control, Ozonation, Water treatment facilities, Computers.

A fully automated system is used to control a two-stage ozonation system treating 140,000 cu m/h (6.4 mgd) of potable water in a full-scale water treatment plant. A supervisory computer has a data communications path to each of six ozone generators and a direct link to the ozone destruct system. Total ozone requirement is calculated, the most power-efficient equipment configuration is selected, and the flow of ozone to each contactor is controlled. In addition, graphic display of equipment status and process variables is provided, system events are logged, and strip charts and reports are produced. (See also W87-06492) (Author's abstract)
W87-06516

EDUCATIONAL INTERVENTION FOR ALTERING WATER-SANITATION BEHAVIORS TO REDUCE CHILDHOOD DIARRHEA IN URBAN BANGLADESH: I. APPLICATION OF THE CASE-CONTROL METHOD FOR DEVELOPMENT OF AN INTERVENTION,
International Centre for Diarrheal Disease Research, Dacca (Bangladesh).
For primary bibliographic entry see Field 5G. W87-06541

EDUCATIONAL INTERVENTION FOR ALTERING WATER-SANITATION BEHAVIORS TO REDUCE CHILDHOOD DIARRHEA IN URBAN BANGLADESH: II. A RANDOMIZED TRIAL TO ASSESS THE IMPACT OF THE INTERVENTION ON HYGIENIC BEHAVIORS AND RATES OF DIARRHEA,
International Centre for Diarrheal Disease Research, Dacca (Bangladesh).
For primary bibliographic entry see Field 5G. W87-06542

INTERIM PRIVATE WATER WELL REMEDIATION USING CARBON ADSORPTION,
Warzyn Engineering, Inc., Madison, WI.
D. W. Hall, and R. L. Mumford.

Ground Water Monitoring Review GWMRDU, Vol. 7, No. 1, p 77-83, Winter 1987. 3 fig, 4 tab, 12 ref.

Descriptors: *Petroleum products, *Carbon adsorption, *Water treatment, *Water pollution treatment, *Gasoline, *Carbon filters, Filter media, Hydrocarbons, Field tests, Iron, Seepage.

Contamination of private wells by a gasoline station near Wausau, Wisconsin provided the opportunity to test the ability of carbon adsorption to effectively treat well water as an interim remedial action while a prolonged investigation goes on. The concentrations and types of organic compounds in the water determine the cost-effectiveness of using carbon adsorption. Each organic compound has a characteristic affinity for a particular carbon, which ultimately determines the life of the carbon adsorption unit before replacement is necessary. Water quality testing for volatile organics at the private water supply wells indicated the type and concentration of gasoline-related contaminants. The data were used to conservatively estimate the expected life of the carbon adsorption unit. Continued periodic water quality analyses determine the actual carbon life. The carbon adsorption systems initially functioned beyond their estimated capacities and successfully removed organics from the affected water supplies (3 1/2 months actual versus 3 months expected at one well, 6 months actual versus 3 1/2 months at another). However, earlier breakthrough (2 months) occurred at the first well after tank rotation. This experience pointed out the value of periodic system testing, to evaluate effectiveness or to re-evaluate carbon requirements. In addition, one well required additional treatment to optimize effective adsorption performance, and to solve an iron discoloration and taste problem. (Airone-PTT)
W87-06574

WATER REUSE,
Water Pollution Control Federation, Washington, DC.
For primary bibliographic entry see Field 5D.
W87-06621

5G. Water Quality Control

DETERMINISTIC MODEL FOR FORECASTING LAND PLANNING EFFECTS ON A LAKE ECOSYSTEM,
Pavia Univ. (Italy). Dipt. di Idraulica e Disinquinamento.
For primary bibliographic entry see Field 2H.
W87-05929

IMPACT OF HYPOLIMNETIC AERATION ON ZOOPLANKTON AND PHYTOPLANKTON POPULATIONS,
York Univ., Downsview (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W87-05938

NONPOINT-SOURCE POLLUTION CONTROL: THE USDA POSITION,
Department of Agriculture, Washington, DC.
P. C. Myers.
Journal of Soil and Water Conservation JSWCA3, Vol. 41, No. 3, 156-158, May-June 1986.

Descriptors: *USDA, *Nonpoint pollution sources, Legislation, Erosion, *Water pollution sources, *Pollution control, Foresters, Environmental Protection Agency, Government task forces, Government interrelations, Water quality, Water law.

The U.S. Department of Agriculture subscribes to the policy developed by the Nonpoint-Source Task Force. The policy calls for agencies to emphasize priority waters in nonpoint-source control programs. One way to translate this policy into action is to establish priorities at the local level. The voluntary complicance approach now used in USDA's conservation programs is not perfect, but it is far more effective and less costly than the alternative. Among federal agencies, the record of cooperation and action is strong and getting stronger. Three factors that could influence the effectiveness of the program are: the 1985 Farm Bill, the EPA proposal, and reauthorization of the Clean Water Act. Based on the USDA's extensive water quality management experience 11 principles for implementing any voluntary nonpoint-source program are listed. (Main-PTT)
W87-05961

HEAVY METALS IN LANDFILL LEACHATE,
Geraghty and Miller, Inc., Hackensack, NJ.
For primary bibliographic entry see Field 5B.
W87-05988

BUFFERING ACID PRECIPITATES, REDUCING SOIL EROSION, AND RECLAIMING TOXIC SOIL IN THE ADVENT OF GLOBAL HUMAN CARRYING CAPACITY,
State Univ. of New York Coll. of Environmental Science and Forestry, Syracuse.
R. Hartenstein.
International Journal of Environmental Studies IJEVAW, Vol. 27, No. 3/4, p 287-300, 1986. 1 fig, 3 tab, 76 ref.

Descriptors: *Acid rain, *Soil erosion, *Soil management, *Carrying capacity.

The earth may reach its human carrying capacity within the next 2-4 generations. This will likely lead to (1) the application of inorganic fertilizer without simultaneous addition of metastable forms of organic molecules; (2) the release of inorganic nitrogen and sulfur from fossil fuel in excess of what can be organified within soil and by biological organisms; (3) production of increasing amounts of livestock in response to economic demand; and (4) landfilling increasing amounts of domestic and industrial organic wastes. The objective of this paper is to advance several well established but somewhat obscure and heretofore uncollated science principles which could significantly reduce the potential severity of the above mentioned problems. Natural organic wastes and earthworm biotechnology may be used to increase soil buffering capacity for acid precipitants, amend arable soil to reduce its tendency toward erosion, and reclaim certain portions of land presently desertified due to toxic soil conditions. (Author's abstract)
W87-05992

SUCCESSION THEORY, EUTROPHICATION, AND WATER QUALITY MANAGEMENT,
Loyola Univ. of Chicago, IL. Dept. of Natural Science.
For primary bibliographic entry see Field 2H.
W87-05994

RESPONSE OF AQUATIC VEGETATION TO SEDIMENTATION DOWNSTREAM FROM RIVER CHANNELISATION WORKS IN ENGLAND AND WALES,
Freshwater Biological Association, Wareham (England). River Lab.
A. Brookes.
Biological Conservation BICOBK, Vol. 38, No. 4, p 351-367, December 1986. 6 fig, 1 tab, 58 ref. Natural Environment Research Council CASE studentship GT4/80/AAPS/44.

Descriptors: *Sediment, *Channeling, *Rooted aquatic plants, Canal construction, Silt.

Aquatic vegetation was measured at four sites of river channelization works: Wallop Brook and Ober Water, both in Hampshire, the River Wyle in Wiltshire, and the River Cale in Somerset. Physical factors determine the nature and extent of downstream deposition of sediment arising during construction. Depending on the depth of the sediment, individual plant species may respond either by varying their rooting levels or by becoming smothered. The suspended sediment released was silt and did not abrade plant parts. Post-construction deposits were a short-term phenomenon, being washed out during flood events, thereby facilitating recovery of vegetation. Recommendations for minimizing the impact of sedimentation due to construction include limiting disruption to the bed and bank; minimizing the volume of excavation; carefully selecting the time of year when the work is performed; and rapidly plugging the old channel at a site of channel realignment. (Airone-PTT)
W87-06002

REVIEW OF THE ISRAELI TECHNICAL COMMITTEE FOR ASBESTOS,
Tel-Aviv Univ. (Israel). Research Inst. for Environmental Health.
S. Brenner, and Z. Anavi.
American Journal of Industrial Medicine AJIMD8, Vol. 10, No. 5/6, p 527-532, 1986. 1 tab, 4 ref, 3 append.

Descriptors: *Institutions, *Reviews, *Israel, *Public health, *Asbestos, *Water pollution, *Air pollution, Standards, Monitoring, Dusts, Wastes, Drinking water.

The concern of the Israeli public regarding the health hazards of asbestos has led to the formation of a government body responsible for finding solutions to the problem. This body was formed in 1983 as a National Medical Committee and included representatives from government and the private sector. The Israeli Technical Committee for Asbestos, a subsidiary of the Committee, deals with the technical aspects of asbestos and other dust hazards. The major activities of the Technical Committee during the past two years are reviewed. During this period, this committee has held ten meetings and has conducted a preliminary study on problems of silica. The main objective was to perform periodic reviews of technical paragraphs of the regulations and to suggest amendments based on international reports and local observations. Topics discussed in the review include standards for the working and public environments, emission standards, asbestos-cement fibers in drinking water, substitutes for asbestos, and asbestos waste. (Author's abstract)
W87-06015

DRINKING-WATER AND SANITATION: A VILLAGE IN ACTION,
Ban Phai District Hospital (Thailand).
A. Menaruchi.
World Health Forum WHFODN, Vol. 7, No. 3, p 303-306, 1986.

Descriptors: *Drinking water, *Sanitation, *Thailand, *Case studies, *Public health, *Project planning, *Water quality management, Social aspects, Planning, Public participation, Public policy, Economic aspects.

A comparative study on the effectiveness of a project for improving drinking water supplies and sanitation facilities was undertaken in two Thai villages. The aims of the study were (1) to establish a village sanitation cooperative fund; (2) to develop the necessary management skills among the villagers; (3) to train village craftsmen to construct the required facilities; (4) to evaluate the effectiveness of the development model; and (5) to judge the results of the project. After nine months, improvements were found in the knowledge, attitudes, and practices of the people in the experimental village relative to the control village. The most significant differences were in the numbers of new water-storage jars and water-seal latrines; personal hygiene was less affected. Follow-up, supervision, and evaluation of the craftmen's work was found to be very important. Success of the project was found to depend on income levels, the relationships between villagers and government health workers, and training and motivation of the villagers. (Doria-PTT)
W87-06016

CURRENT AND FUTURE ENVIRONMENTAL ISSUES AS SEEN FROM THE PRIVATE SECTOR,

ABC Research Corp., Gainesville, FL.
W. L. Brown.
Cereal Foods World CWFODA, Vol. 31, No. 11, p 800-802, November 1986. 14 ref.

Descriptors: *Environmental management, *Environmental protection, *Planning, *Water policy, *Water quality standards, *Crop production, *Public policy, Environmental policy, Food processing industry, Recycling, Standards, Sanitation, Water quality management, Pathogenic bacteria, Bacteria.

Chemical and microbial environmental problems related to the food industry are reviewed; these include groundwater, raw materials, by-products, and a total systems approach for improving environmental controls in the food industry. Topics covered include nitrate contamination of water, pesticide residues in food and in the environment, food-borne diseases, groundwater protection, better use of raw materials, the use of microorganisms to convert waste products into protein and energy, and advances in biotechnology. It is predicted that the food plant of the future will be highly automated, utilizing reused water and obtaining power from a hydrogen fuel cell or a small atomic-plant unit; plant waste will be incinerated, with waste and heat being recycled. It is concluded that the total agricultural production system must be analyzed to make significant, permanent changes in the environment. Recommendations include: (1) crop breeding for processing efficiency; (2) development of improved, environmentally sound methods for food plant cleaning and sanitizing; (3) development of safe pest control methods; and (4) new uses for by-products, leading to zero waste discharge. (Doria-PTT)
W87-06019

USE OF SEVIN ON ESTUARINE OYSTER BEDS IN TILLAMOOK BAY, OREGON,
A. B. Bakalian.
Coastal Zone Management Journal CZMJBF, Vol. 13, No. 1, p 49-83, 1985. 138 ref.

Descriptors: *Legal aspects, *Regulations, *Legislation, *Federal jurisdiction, *State jurisdiction, *Pesticides, *Sevin, *Environmental effects, *Environmental protection, *Estuarine environment, *Estuaries, *Oysters, *Tillamook Bay, Environment, Protection, Tides, Oregon, Spraying.

The various federal and state regulatory schemes were examined in relation to the direct application of pesticides on estuarine tidelands, that part of estuaries covered and uncovered by the ebb and flow of tides. The proposed use of cabaryl 80 (Sevin) on the Tillamook Bay oyster tidelands to control alleged infestations of mud shrimp and ghost shrimp was examined. Federal pesticide control laws in relation to a state's authority to sanction alternative uses of a federally registered pesticide were discussed. Oyster cultivation practices in Tillamook Bay and the authority of the Oregon Fish and Wildlife Commission, its 1982 decision to allow the use of Sevin, and the subsequent appeals by three environmental organizations to the Oregon Supreme Court were reviewed. The role of the public trust doctrine in Oregon's estuaries is explored regarding the extent to which that doctrine may be applied to protect estuarine resources. A parallel land-use issue that culminated in a 1984 Oregon Court of Appeals decision prohibiting any spraying based on the Commission's failure to comply with the inventory provisions of Goal 16 of Oregon's Coastal Goals regarding the protection of estuarine resources was examined. (Author's abstract)
W87-06075

DESIGN OF A DRINKING WATER QUALITY MONITORING PROGRAM,
Massachusetts Univ., Amherst. Water Resources Research Center.
P. J. Godfrey, A. Ruby, O. T. Zajicek, S. J. DeFrancesco, and M. Sutherland.
Available from the National Technical Information Service, Springfield, VA 22161 as PB87 112439/AS, Price codes: A06 in paper copy, A01 in microfiche. Completion report for a project funded by the Massachusetts Department of Environmental Quality Engineering. Publication No. 154, August 1986. 111 p, 7 fig, 10 tab, 57 ref, append.

Descriptors: *Acidic water, *Drinking water, *Leaching, *Water supply systems, *Chemical properties, *Monitoring, *Massachusetts, Pipes, Acid rain, Acid streams, Acidity, Water properties, Water distribution, Municipal water, Chemical analysis.

The impact of acid deposition on drinking water quality has received little attention by the national acid deposition research program. Yet acid deposition may impair drinking water by depositing contaminants in surface water supplies, leaching contaminants from supply watersheds, or corroding distribution systems, and consequently, dissolving contaminants into drinking water. A review of the existing literature on the impacts of acid deposition and the effect of acidic water on drinking water quality has revealed that the majority of surface water supplies in Massachusetts are vulnerable to acidification, that surface water supplies have experienced historical losses of acid neutralizing capacity, and that the primary potential cause of acidification-related water quality degradation of household drinking water is the corrosion of water supply distribution pipes. This report's conclusions are based primarily on a review of the findings of the Acid Rain Monitoring Project of the Massachusetts Water Resources Research Center, the work of Taylor et al (1985) on historical changes in acidity of 34 Massachusetts Water supplies, an investigation of 158 Massachusetts municipal drinking waters using the Langelier Agressive Index, by Zajicek (1981), Francis et al's 1984 National Statistical Assessment of Rural Water Conditions, and the records of the Lawrence Experiment Station. (Kaynor-U.MA)
W87-06077

NITROGEN FERTILIZER MANAGEMENT TO REDUCE WATER POLLUTION POTENTIAL,
Illinois Univ. at Urbana-Champaign. Dept. of Agronomy.
R. G. Hoeft, S. E. Hollinger, and R. M. Vanden Heuvel.
Avaiable from the National Technical Information Service, Springfield, VA 22161, as PB87 131793/AS, A02 in paper copy, A01 in microfiche. Illinois State Water Survey Division, Champaign, Climate and Meteorology Section, SWS Contract Report 395, June 1986, 11 p, 11 tab, 1 ref. Contract No. 14-08-0001-G1015, Project No. USGS G1015-06.

Descriptors: *Groundwater pollution, *Nitrogen loss, *Water pollution control, Leaching, Denitrification, Illinois, Excess rainfall, Rainfall intensity, Soil moisture levels.

Both environmental and economic concerns have resulted in renewed interest in the potential for nitrogen loss under various climate conditions. Experiments were conducted at three locations in Illnois to evaluate the effect of soil type, nitrogen rate, and excessive soil moisture levels on the potential for nitrogen loss. Addition of 10 cm of excessive water during the early part of the growing season resulted in N loss estimates of about 20 kg/ha on a silty clay loam at DeKalb and a sand at Havana. Increasing the excess water levels to 15 cm increased the N loss to 50 to 70 kg/ha at the same two locations, respectively. Since excessive rains in the fall prevented the collection of soil samples to use in monitoring nitrogen movement, conclusive results are not available to indicate the relative magnitude of loss from leaching and denitrification at these two locations. However, it is likely that a majority of the loss at the Havana site would have been through leaching, whereas at the DeKalb site most of the loss was probable due to denitrification. (Hoeft-IL S Water Survey)
W87-06094

CHARACTERIZATION OF A LANDFILL-DERIVED CONTAMINANT PLUME IN GLACIAL AND BEDROCK AQUIFERS, NE ILLINOIS,
Northern Illinois Univ., De Kalb. Dept. of Geology.
For primary bibliographic entry see Field 5B.
W87-06095

ROLE OF STREAMBED BIOFILMS IN THE REMOVAL OF BIODEGRADABLE CONTAMINANTS FROM SHALLOW STREAMS,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
C. J. Gantzer, B. E. Rittmann, and E. E. Herricks.
Available from the National Technical Information Service, Springfield, VA 22161 as PB87 131744/AS, Price codes: A06 in paper copy, A01 in microfiche. Illinois Water Resources Center, Urbana-Champaign, UIUC-WRC-86-203, WRC Research Report No. 203, September 1986. Project No. S-098-ILL.

Descriptors: *Biodegradation, *Biofilms, *Mass transport, *Simulation, Artificial streams, Kinetic models, Shallow streams, Water quality models.

Biological activity in shallow streams is dominated by biofilms which are attached to the surfaces of the streambed. Although biofilm kinetic models are well developed and are successfully applied to biological treatment process, they cannot be applied directly to predict water quality in shallow streams, because the area and mass-transport aspects of streambed biofilms are complicated and not defined. Therefore, the main purpose of this study was to develop area and mass-transport functions for cobble and conduct kinetic experiments on the biofilm utilization of an easily degraded sugar. Media size (i.e., cobble or gravel) and flow velocity were varied over a wide range of values typical to shallow streams. Water velocity had short-term and long-term effects on the rate of contaminant removal. The short-term effects were related to increased mass-transport kinetics for higher flow velocities, while the long-term effects also included increased surface colonization by biofilm. The cobble streambed was more sensitive to short-term changes in water velocity than was the gravel bed, and it gave faster removal kinetics. Equations to predict the mass transfer coefficients were appropriate for more than one biofilm community, as long as the same medium size was used. The simulations from the water quality models containing the biofilm reaction term were markedly different from the simulations from traditional water-quality models that use only suspended-organism kinetics. (Stout-IL Water Res Ctr)
W87-06098

MULTICRITERIA MANAGEMENT OF GROUNDWATER QUALITY UNDER UNCERTAINTY,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
J. W. Eheart, and A. J. Valocchi.
Available from the National Technical Information Service, Springfield, VA 22161 as PB87 131728/AS, Price codes: A03 in paper copy, A01 in microfiche. Illinois Water Resources Center, Urbana-Champaign, UIUC-WRC-86-201, WRC Research Report No. 201, 1986. 40 p, 8 fig, 6 tab, 30 ref. Contract No.14-08-0001-G904, Project No. USGS G904-03.

Descriptors: *Groundwater pollution, *Groundwater management, *Risks, *Stochastic processes, Mathematical models, Groundwater quality, Aquifers, Marginal Sensitivity Technique, Parameter Configuration Technique.

The primary purpose is to incorporate parameter uncertainty into the development of multicriteria planning and management tools for groundwater quality problems. Two different stochastic management tools have been developed in this project--The Marginal Sensitivity Technique (MST), and the Parameter Configuration Technique (PCT). The former technique designs a 'best' pumping scheme with respect to cost and parameter sensitivity and determines the tradeoff between these two criteria. The latter technique seeks to identify unfavorable (but physically plausible) spatial distributions of groundwater parameters. The MST has been applied to a simple hypothetical problem involving uniform flow through a two dimensional, homogeneous aquifer. The MST

shows that it is possible to increase pumping (i.e., cost) in such a way so as to manipulate the groundwater system into states of low sensitivity to parameter changes. A hypothetical example problem was constructed to illustrate the use of the PCT. Two pumpout schemes were designed, under the assumption of uniform transmissivity; one scheme was based on one extraction well, the other on one extraction and one injection well. The least-cost design (pumping scheme) of each was then subjected to a PCT-generated transmissivity field. For the data set used, the least-cost one-well scheme captured 85% of the contaminant and the two-well design captured 86%. (Stout-ILWR)
W87-06099

URBAN STORM RUNOFF IN HAWAII,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 5B.
W87-06106

UTILIZATION OF FLEXIBLE MEMBRANE TO IMPOUND RUNOFF WATER IN RECEIVING COAST FOR WATER CONSERVATION AND QUALITY CONTROL,
Hawaii Univ. at Manoa, Honolulu. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8A.
W87-06116

CHEMICAL PROCESSES IN LAKES.
For primary bibliographic entry see Field 2H.
W87-06126

LAKE RESTORATION,
Eidgenoessische Technische Hochschule, Zurich (Switzerland).
For primary bibliographic entry see Field 2H.
W87-06142

EFFECTS OF LIMING AND FERTILIZER APPLICATIONS TO ACID SULFATE SOILS FOR IMPROVEMENT OF RICE PRODUCTION IN THAILAND,
Ministry of Agriculture and Cooperatives, Bangkok (Thailand). Dept. of Land Development.
C. Charoenchamratcheep, B. Tantisira, P. Chitnuson, and V. Sin-Aiem.
IN: Proceedings of the Bangkok Symposium on Acid Sulphate Soils, Second International Symposium on Acid Sulphate Soils, Bangkok, Thailand, January 18-24, 1981. ILRI Publication 31, 1982. p 157-171, 6 tab, 10 ref.

Descriptors: *Soil reclamation, *Soil-water-plant relationships, *Water pollution effects, *Acidic soils, *Acid sulfates, *Rice, *Thailand, Agriculture, Lime, Fertilizers, Ammonium sulfate, Phosphates, Marl.

Acid sulfate soils cover quite a large area in the Central Plain of Thailand which is an important rice producing region of the country. As a result of the low pH and the low fertility of these soils, rice yields are very low to low. To increase rice production and to maximize the net profit, improvement of acid sulfate soils by liming and fertilizer applications was studied and the results are reported in this paper. In moderately acid soils, Maha Phot and Ayutthaya series, application of marl had little effect on yield. Applying ammonium sulfate alone (150 kg/ha) or with Thai rock phosphate (1.250 kg/ha) tended to give a high yield. Either marl at 6.25 to 12.5 tons/ha with ammonium phosphate at 187.5 kg/ha or ammonium sulfate alone may be applied to maximize net profit. In the severely acid Rangsit soil, rice responded strongly to marl (6.25 to 18.75 tons/ha) with ammonium phosphate (187.5 kg/ha). A similar response was obtained with 6.25 to 12.5 tons/ha of marl, 1250 kg/ha of Thai rock phosphate and 150 kg/ha of ammonium sulfate or 12.5 tons/ha of marl with 187.5 kg/ha of ammonium phosphate gave the highest yield response and the maximum profit. In all soils at all locations, the results indicate that liming plays a significant role in increasing the efficiency of fertilizers. (See also W87-06162) (Lantz-PTT)
W87-06171

STUDY ON RATES OF MARL FOR RICE PRODUCTION ON ACID SULPHATE SOILS IN THAILAND,
Ministry of Agriculture and Cooperatives, Bangkok (Thailand). Dept. of Land Development.
M. Maneewon, N. Thawornwong, and B. Tantisira.
IN: Proceedings of the Bangkok Symposium on Acid Sulphate Soils, Second International Symposium on Acid Sulphate Soils, Bangkok, Thailand, January 18-24, 1981. ILRI Publication 31, 1982. p 172-186, 10 tab, 9 ref.

Descriptors: *Soil reclamation, *Soil-water-plant relatioships, *Marl, *Rice, *Acidic soils, *Thailand, *Water pollution effects, Agriculture, Sediments, Field tests, Fertilizers, Cost analysis.

Field experiments were conducted in three series of acid sulfate soils which varied in soil acidity and land capability classes for paddy. In an extremely acid soil, application of both marl and fertilizers greatly increased grain yield of rice, and produced a significant increase in profit. In a severely acid soil, marl alone gave no significant effect on total yield over four years, but in some years there were indications that liming is beneficial for the soil. This needs to be studied in relation to climatic patterns. Liming the soil at the rate of 3.1 tons/ha with fertilizers gave the highest profit. In a moderately acid sulfate soil, fertilizers alone are enough for improving yields. However, marling the soil at the rate of 3.1 tons/ha together with fertilizers was superior over application of fertilizers alone, and gave the highest profit. The extra money revenue could cover the cost of marling. (See also W87-06162) (Lantz-PTT)
W87-06172

ROCK PHOSPHATE IN RICE PRODUCTION ON ACID SULPHATE SOILS IN VIETNAM,
Can Tho Coll. (Vietnam). Faculty of Agriculture.
L. V. Can.
IN: Proceedings of the Bangkok Symposium on Acid Sulphate Soils, Second International Symposium on Acid Sulphate Soils, Bangkok, Thailand, January 18-24, 1981. ILRI Publication 31, 1982. p 187-194, 1 fig, 4 tab, 12 ref.

Descriptors: *Soil reclamation, *Phosphates, *Acidic soils, *Acid sulfates, *Vietnam, *Rice, *Water pollution sources, *Red River, *Path of pollutants, Mekong Delta, Phosphorus, Iron hydroxide.

In Vietnam acid sulfate soils cover over 2 million ha in the Mekong Delta in the South and over 200,000 ha in the Delta of the Red River in the North. Rock phosphate is mined from large deposits at Lao Cai in the North and has been tried there as fertilizer for paddy production on various soils since 1960, with positive results on acid soils low in phosphorus, especially on acid sulfate soils. On the acid sulfate soils, low grade Lao Cai phosphate gives a strong residual effect which is explained by the formation of iron hydroxide coatings on its microcrystalline grains. Since 1975 the Lao Cai phosphate has been introduced successfully in paddy production on acid sulfate soils in the Mekong Delta as a replacement of imported phosphates. Demand for Lao Cai phosphate in the South is now increasing rapidly and the government is giving high priority to its transportation and distribution as well as to exploration for local deposits of natural phosphate. (See also W87-06162) (Lantz-PTT)
W87-06173

MANAGEMENT OF ACID SULPHATE SOILS IN THE MUDA IRRIGATION SCHEME, KEDAH, PENINSULAR MALAYSIA,
Malaysian Agricultural Research and Development Inst., Serdang. Rice Research Branch.
X. Arulandoo, and K. S. Pheng.
IN: Proceedings of the Bangkok Symposium on Acid Sulphate Soils, Second International Symposium on Acid Sulphate Soils, Bangkok, Thailand, January 18-24, 1981. ILRI Publication 31, 1982. p 195-212, 2 fig, 9 tab, 8 ref.

Descriptors: *Soil reclamation, *Acidic soils, *Irrigation practices, *Kedah, *Malaysia, *Water pollution effects, Acid sulfates, Rice, Agriculture, Iron, Lime, Potassium, Phosphorus, Nitrogen.

Field trials were conducted to study the influence of rice straw, lime and fertilizers on rice grown on acid sulfate soils. Rice frequently shows iron toxicity symptoms in unamended fields, particularly during the dry season. Lime application at the rate of 2.5 tons/ha increased rice yields substantially through a general improvement in crop growth and plant nutrient status. There was a clear residual effect of lime in the subsequent rice crop. Incorporation of crop residue increased dry matter production, plant potassium content and grain yield. There was no residual effect of rice straw incorporation in the subsequent rice crop. Nitrogen, phosphorus and potassium fertilizers are needed for maximizing rice yields. Favorable responses were obtained with the application of 90 kg N/ha, 50 kg P2O5/ha and 40 kg K2O/ha. In the absence of phosphorus application, phosphorus deficiency symptoms were prevalent and caused a delay in maturity of the crop by about two weeks. Potassium application at the tillering stage of rice growth increased rice grain yield. (See also W87-06162) (Lantz-PTT)
W87-06174

FIELD AMELIORATION OF AN ACID SULFATE SOIL FOR RICE WITH MANGANESE DIOXIDE AND LIME,
International Rice Research Inst., Los Banos, Laguna (Philippines).
F. N. Ponnamperuma, and J. L. Solivas.
IN: Proceedings of the Bangkok Symposium on Acid Sulphate Soils, Second International Symposium on Acid Sulphate Soils, Bangkok, Thailand, January 18-24, 1981. ILRI Publication 31, 1982. p 213-222, 4 tab, 12 ref.

Descriptors: *Soil reclamation, *Acidic soils, *Rice, *Path of pollutants, *Manganese dioxide, *Lime, *Water pollution effects, Calcium carbonate, Iron, Toxicity, Flooding.

The effects of MnO2 (100 kg/ha) and CaCO3 (5 t/ha) on iron toxicity symptoms and yield of IR26 and IR43 on a flooded acid sulfate soil were studied in a replicated factorial experiment in a farmer's field. The best treatment according to symptoms at 4 and 8 weeks after transplanting was IR43 (a moderately tolerant variety) in the presence of CaCO3 and MnO2. The worst was IR26 (a moderately susceptible variety) in the absence of CaCO3 and MnO2. Analysis of variance of the symptoms scores revealed no significant response to CaCO3, a significant difference between the two varieties, and a highly significant positive response to MnO2. The benefits of MnO2 are attributed to manganese, assisted by CaCO3, counteracting physiologically the toxic effects of excess iron. MnO2, coupled with a tolerant variety and CaCO3, may be an inexpensive ameliorant for acid sulfate soils. (See also W87-06162) (Lantz-PTT)
W87-06175

IMPROVEMENT OF ACID SULFATE SOILS: EFFECTS OF LIME, WOOD ASH, GREEN MANURE AND PREFLOODING,
Djibelor Rice Research Station, Sefa (Senegal).
M. Toure.
IN: Proceedings of the Bangkok Symposium on Acid Sulphate Soils, Second International Symposium on Acid Sulphate Soils, Bangkok, Thailand, January 18-24, 1981. ILRI Publication 31, 1982. p 223-236, 3 fig, 6 tab, 14 ref.

Descriptors: *Acidic soils, *Acid sulfate, *Lime, *Fertilizers, *Senegal, *Water pollution effects,

Mangrove swamps, Rice, Tropical regions, Land reclamation, Saline soils, Leaching.

Attempts to reclaim tropical mangrove swamps for rice production often have resulted in the development of unproductive acid sulfate soils. In Senegal plant performance on these soils is hampered by strong acidity, high salinity and high levels of inorganic and organic toxins. The strategy for improving the soil conditions for rice involves leaching of toxins and subsequently minimizing renewed toxin production through stabilization of the electrochemical situation in the soil. To this end green manure, lime and wood ash were tested as amendments in leached acid sulfate soil material planted to rice in the greenhouse, with and without preflooding. Plant performance, nutrient uptake and kinetics of the soil solution were monitored. Leaching was more beneficial than any of the amendments. Green manure and lime lead to strong reduction and high toxin levels. Wood ash in combination with preflooding decreased the levels of the toxins iron and organic acids. (See W87-06162) (Lantz-PTT)
W87-06176

EFFECTS OF LIME AND PHOSPHORUS ON THE GROWTH AND YIELD OF RICE IN ACID SULPHATE SOILS OF THE CASAMANCE (SENEGAL),
Djibelor Rice Research Station, Sefa (Senegal).
M. Khouma, and M. Toure.
IN: Proceedings of the Bangkok Symposium on Acid Sulphate Soils, Second International Symposium on Acid Sulphate Soils, Bangkok, Thailand, January 18-24, 1981. ILRI Publication 31, 1982. p 237-250, 1 fig, 8 tab, 13 ref.

Descriptors: *Water pollution effects, *Lime, *Phosphorus, *Rice, *Senegal, *Acidic soils, Acid sulfate, Salinity, Saline soils, Soil water.

There are at least 600,000 ha of acid sulfate soils in the coastal plain of Senegal. In the Casamance area, in the South, these soils are used and reclaimed for rice production. Main constraints are the availability of fresh water, toxicities related to high salinity and acidity, and phosphorus deficiency. The topography facilitates control of water levels. In response to proposals of the organizing committee for the Second International Symposium on Acid Sulphate Soils, Bangkok 1981, a factorial field experiment with two rice cultivars, two levels of phosphorus and three levels of lime, was conducted in two sites with acid sulfate soils during the growing seasons of 1979 and 1980. The results were strongly influenced by drought and salinity especially during 1980. No effects of lime on rice yields were noticed. Triple superphosphate had an overall beneficial effect regardless of soil differences and varieties. No significant differences in grain yields between rice varieties were demonstrated. The modern short duration IR 1529 variety suffered from salinity and its growing season was prolonged. It is concluded that with sufficient fresh water and correction of phosphorus deficiency, rice production is feasible on acid sulfate soils in Senegal. (See also W87-06162) (Lantz-PTT)
W87-06177

RICE CULTIVATION ON ACID SULPHATE SOILS IN THE VIETNAMESE MEKONG DELTA,
Can Tho Coll. (Vietnam).
V. T. Xuan, N. K. Quang, and L. Q. Tri.
IN: Proceedings of the Bangkok Symposium on Acid Sulphate Soils, Second International Symposium on Acid Sulphate Soils, Bangkok, Thailand, January 18-24, 1981. ILRI Publication 31, 1982. p 251-259, 4 fig.

Descriptors: *Water pollution effects, *Acidic soils, *Vietnam, *Rice, Agriculture, Drainage systems, Acid sulfates, Rainfall.

In the Mekong Delta of Vietnam an estimated 60% of the land is affected by acid sulfate soil conditions. By trial and error, local rice farmers have developed various management systems that overcome or minimize the adverse soil conditions. Two popular and successful practices applied for rainfed rice are described: (1) the intensive shallow drainage system, yielding up to 4 t/ha of paddy on shallow-developed and potential acid sulfate soils, and (2) the acid avoidance practice yielding up to 6 t/ha on well developed acid sulfate soils. (See also W87-06162) (Lantz-PTT)
W87-06178

EFFECT OF WATER MANAGEMENT ON FIELD PERFORMANCE OF OIL PALMS ON ACID SULPHATE SOILS IN PENINSULAR MALAYSIA,
Harrisons and Crosfield (Malaysia), Kuala Lumpur.
T. P. Yin, and P. Y. Chin.
IN: Proceedings of the Bangkok Symposium on Acid Sulphate Soils, Second International Symposium on Acid Sulphate Soils, Bangkok, Thailand, January 18-24, 1981. ILRI Publication 31, 1982. p 260-271, 2 fig, 2 tab, 10 ref.

Descriptors: *Acidic soils, *Water management, *Malaysia, *Water pollution effects, *Oil palms, Acid sulfates, Drainage systems, Water table, Soil horizons.

There is a relationship between oil palm yields and the depth at which the acidic horizon occurs. Acidic horizons below 90 cm have virtually no effect on palm yields. On the other hand, where the acidic layers occur within 60 cm of the soil surface, yield levels will be reduced. In the severely and moderately acid areas, yields improved appreciably when after a period of deep drainage, the water table was raised, with increases of 36.3% and 17.6% being recorded respectively in the first consecutive four year period after raising the water table. Fortunately, such areas of severe acidity are usually discontinuous and reclamation of acid sulfate areas as a whole for oil palm cultivation, is highly economic. The recommended drainage pattern, with the location of water retention blocks at strategic points as described, has improved the yield performance of oil palms considerably over many years. It is now envisaged that there are relatively few problems with the growth of oil palms on acid sulfate soils provided that the hyritic horizon is not too shallow and the areas do not experience prolonged dry spells. (See also W87-06162) (Lantz-PTT)
W87-06179

PROBLEMS IN RECLAIMING AND MANAGING TIDAL LANDS OF SUMATRA AND KALIMANTAN, INDONESIA,
Euroconsult, Arnhem (Netherlands).
L. J. Eelaart.
IN: Proceedings of the Bangkok Symposium on Acid Sulphate Soils, Second International Symposium on Acid Sulphate Soils, Bangkok, Thailand, January 18-24, 1981. ILRI Publication 31, 1982. p 272-290, 2 fig, 11 ref.

Descriptors: *Land reclamation, *Tide lands, *Sumatra, *Kalimantan, *Indonesia, Wetlands, Rainfall, Rice, Agriculture, Water table, Soil water, Irrigation, Drainage systems.

Tidal lands of Indonesia are cultivated on a large scale. Spontaneous or government-sponsored transmigration and reclamation proceed at a very fast rate at present. The soils of tidal lands reclaimed for rice cultivation in Indonesia are highly permeable and therefore have no or only a shallow water layer on the fields during the peak of the wet season. Yet they have high ground water tables throughout the year. Tidal irrigation is confined only to areas close to the rivers. Deep flooding can occur only where tidal action is weak or absent. In South and Central Kalimantan experiments with a rainfed double rice cropping system using drought-resistant varieties seem promising. For the tidal lands project, sponsored by the World Bank (IBRD), a short duration dryland crop after rice is proposed. A gradual lowering of ground water tables over the years to improve conditions for the dryland crop is probably necessary. Preliminary observations in farmers fields indicate that such a dryland crop is possible even in potential acid sulfate soils. An additional positive effect of such a system is easier weed control. A dense network of shallow field ditches with automatic flapgates to control water levels would provide the required dry-season water management. Excessive lowering of the ground water table at the end of the dry season can be prevented by letting in tidal water through the flapgate structure. Upland tree crops can be grown well in tidal lands. By means of locally developed reclamation and planting techniques, coconu cultivation has become quite successful. (See also W87-06162) (Lantz-PTT)
W87-06180

RAPID RECLAMATION OF BRACKISH WATER FISHPONDS IN ACID SULFATE SOILS,
International Rice Research Inst., Los Banos, Laguna (Philippines).
R. Brinkman, and V. P. Singh.
IN: Proceedings of the Bangkok Symposium on Acid Sulphate Soils, Second International Symposium on Acid Sulphate Soils, Bangkok, Thailand, January 18-24, 1981. ILRI Publication 31, 1982. p 318-353, 6 fig, 3 tab, 14 ref.

Descriptors: *Land reclamation, *Brackish water, *Fish ponds, *Acidic soils, *Water pollution effects, Acid sulfate, Agriculture, Tide lands, Saline water, Dikes, Milkfish.

The reclamation of acid sulfate soils for agriculture is generally considered to be a slow process. The productivity of brackish water fish ponds in these soils also remains poor for 5 to 15 years after construction or deepening. However, the water management possibilities inherent in the operation of brackish water fish ponds in tidal areas with a dry season enable the operators to reclaim both the pond bottoms and the surrounding dikes in one dry season, without a need for expensive chemical amendments. The procedure involves thorough drying and dry cultivation of the pond bottom until it cracks to a depth of about 10-cm, followed by repeated inundation with saline or brackish water. The water is renewed every few days until its pH remains above 5. The surrounding dikes are reclaimed at the same time. First, low paddy bunds are built along the edges of the flat crests of the dikes or a small ditch is dug along the center. Cross bunds are constructed wherever the elevation of the dike changes. Saline or brackish water is then pumped into the enclosed shallow basins or ditches on top of the dikes in the same periods in which the pond bottoms are flushed. The dikes are allowed to dry out again at the same time as the pond bottoms. With this procedure, brackish water fish ponds in acid sulfate soils were made productive within one dry season after construction or deepening. Milkfish (Chanos chanos) harvests were about 0.4 to 0.5 t/ha every 4 months, the same as from well management brackish water fish ponds in non-acid marine clays, and there were no fish kills after rain in the treated ponds. (See also W87-06162) (Lantz-PTT)
W87-06183

MANAGEMENT OF ACID SULFATE SOILS FOR BRACKISH WATER FISHPONDS: EXPERIENCE IN THE PHILIPPINES,
Brackish Water Aquaculture Center, Leganes, Iloilo (Philippines).
V. P. Singh.
IN: Proceedings of the Bangkok Symposium on Acid Sulphate Soils, Second International Symposium on Acid Sulphate Soils, Bangkok, Thailand, January 18-24, 1981. ILRI Publication 31, 1982. p 354-367, 1 fig, 4 tab, 12 ref.

Descriptors: *Acidic soils, *Fish ponds, *Water pollution effects, *Philippines, Productivity, Hydrogen ion concentration, Acid sulfates, Phosphorus, Aluminum, Fertilizers, Lime, Water management.

The productivity of fish ponds in acid sulfate areas is influenced by their state of reclamation, the treatment of the pond bottom between fish crops, the time and mode of fertilizer applications, fish stocking rates and timing. In acid sulfate areas, pH values of air-dry soil in water below 5 are correlated with deficient levels of available P and below

4.5, with potentially hazardous concentrations of aluminum. Very strongly acid pond soils remain the same for more than a month after inundation. When small amounts (0.5 t/ha) of lime are distributed on the surface before inundation, the pH rises rapidly owing to soil reduction. Growth of algae was best in supernatant of partly reclaimed acid sulfate soil limed on the surface with 0.5 t/ha of agricultural lime when nitrogen and phosphate fertilizers were applied in frequent, small doses and in 2:1 to 4:1 N:P2O5 ratio. Regardless of the rate of P2O5 application, its effect lasted less than 2 weeks. Large lime applications by themselves are not effective in reclaiming acid sulfate fish ponds. Moderate applications work well in combination with reclamation by the tillage and flushing methods previously described. (See also W87-06162) (Lantz-PTT)
W87-06184

SOME SELECTED EXAMPLES OF EUTROPHICATED EUROPEAN LAKES,
Commission of the European Communities, Ispra (Italy). Joint Research Centre.
For primary bibliographic entry see Field 2H.
W87-06189

NEW CHALLENGES TO ECOTOXICOLOGY,
Commission of the European Communities, Brussels (Belgium).
J. Smeets, and R. Amavis.
IN: Pollutants and Their Ecotoxicological Significance, John Wiley and Sons, Chichester, England, 1985. p 465-477, 2 tab.

Descriptors: *Ecological effects, *Toxicology, *Legislation, Chemical industry, Legal aspects, Risk assessment, Regulations.

The current international development legislation on chemical substances leads to new dimensions in operational ecotoxicology and research. Mandatory rules are established or envisaged to prevent the marketing of chemical substances or mixture known to be dangerous or to present an unreasonable risk, in one way or another, to man and his environment. These legislative measures require an important effort in order to test chemical products to be manufactured, imported or marketed and which have to be notified to the competent authorities. It is estimated that about 1000 new chemicals are introduced every year of which about 500-600 are in the European Economic Community. Many new chemicals are low volume speciality chemicals. Estimates from EPA show that approximately 75% of all chemicals in production in the USA have an annual production volume of less than 45 t. In the European Community it is estimated that only about 2-3% of all chemicals reach a production level of 1000 t/yr, which mean ten to twelve substances yearly. The same estimates indicate that about 20% of all new chemicals are produced in quantities of more than 100 t/yr. The competent authorities have taken the decision that an appropriate control is necessary in order to prevent new serious ecotoxicological threats by chemical substances. This is the objective of the new comprehensive legislation. On the other hand, the legislator acknowledges the role of chemicals in improving the standard of living. In this dilemma of risk benefit, the legislators in the European Communities have very seriously considered the question of the limitation of the cost for the manufacture of new substances. (See also W87-06187) (Lantz-PTT)
W87-06196

INDUSTRY AND THE ENVIRONMENTAL CHALLENGE,
P. S. Friedberg.
IN: Pollutants and Their Ecotoxicological Significance, John Wiley and Sons, Chichester, England, 1985. p 479-509, 8 fig, 9 tab.

Descriptors: *Environmental effects, *Regulations, *Industrial wastes, *Management planning, Water pollution prevention, Water pollution control.

The environmental debate over the last few years has often focused on the industrial enterprise considered, rightly or wrongly, as one of the fundamental factors in the degradation of the modern world. Faced by such criticisms, the industrial enterprise at first adopted an uncertain attitude, either denying that the problem really existed, or debating whether or not it was its concern to face it. Subsequently some empirical solutions were adopted based, in general, on the principle of solving problems as they arose and according to the specific demands of each individual case (pollution and purification, energy crisis and nuclear reactors, etc). Therefore, with some exceptions, no coherent strategic framework was devised to avoid this piecemeal approach because it was thought to be of little practical use and problems, as a rule, were faced separately without a wider overall solution in mind. As a consequence, several solutions were subsequently found to be inadequate, because the complexity of the subject was not fully grasped. Recently, however, the aggravation of certain factors, such as the oil crisis, giving more weight to the economic values, greater pragmatism has become imperative. Accordingly there can no longer be any illusion that a serious commitment of industry to the environment is not necessary. The aim of this chapter is to help such evolution, delineating some elements that the industrial enterprise needs to consider for a strategic approach to the problem. Particular emphasis was placed on (a) the different aspects of the environmental problem, (b) how to face the same, and (c) the relationship between the environmental problem and the general main evolution lines of the modern world. (See also W87-06197) (Lantz-PTT)
W87-06197

BIOASSESSMENT METHODOLOGIES FOR THE REGULATORY TESTING OF FRESHWATER DREDGED MATERIAL, PROCEEDINGS OF A WORKSHOP.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5A.
W87-06200

U.S. FEDERAL LEGISLATION PERTAINING TO GROUNDWATER PROTECTION,
National Water Well Association, Worthington, OH.
J. H. Lehr, D. M. Nielsen, and J. J. Montgomery.
IN: Groundwater Pollution Microbiology, John Wiley and Sons, New York, New York, 1984. p 353-371, 1 fig, 3 tab.

Descriptors: *Federal jurisdiction, *Legislation, *Groundwater quality, *Water quality control, Water pollution, Regulations, Environmental control, Environmental quality.

There are eight major pieces of Federal environmental legislation that either directly or indirectly contribute to the cause of groundwater protection in the United States. No national program exists to tie together all of the various mechanisms utilized in each of the Acts into a comprehensive groundwater protection effort. However, the more recent legislation, including, Federal Water Pollution Control Act, Safe Drinking Water Act, Resource Conservation and Recovery Act, Surface Mining Control and Reclamation Act, provide a framework for such a comprehensive national program to be constructed. Each of these Acts offers its own unique contribution to groundwater protection and, in combination, appear to be sufficiently comprehensive to provide broad protection. Their somewhat diverse objectives and means of attaining them, however, require that the Acts be coordinated more closely to maximize their usefulness in a groundwater protection effort. A comprehensive National Ground Water Protection Strategy, utilizing existing legislation, is needed to accomplish this objective. (See also W87-06201) (Lantz-PTT)
W87-06215

INTRODUCTION TO WATER QUALITY MODELLING.
For primary bibliographic entry see Field 5B.
W87-06216

INTRODUCTION TO MATHEMATICAL MODELLING,
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W87-06217

REMOVAL OF METALS FROM WASTEWATER: NEUTRALIZATION AND PRECIPITATION.
For primary bibliographic entry see Field 5D.
W87-06232

INTERNATIONAL ASPECTS OF ACID DEPOSITION,
North Carolina State Univ. at Raleigh. School of Forest Resources.
E. B. Cowling.
IN: Acid Rain: A Water Resources Issue for the 80's, American Water Resources Association, 5410 Grosvenor Lane, Bethesda, Maryland, 1983. p 3-12, 2 fig, 55 ref.

Descriptors: *Acid rain, *Environmental effects, *England, *Canada, *International commissions, International agreements, Water pollution effects, Germany, Ecological effects.

In recent decades, 'acid rain' has become a dominant feature of anthropogenic change in the chemical climate of the Earth. Wherever fossil fuels are burned, metal ores are smelted, and materials are processed on a large scale, various gaseous, aerosol, and particulate waste products are released into the atmosphere. These substances and their reaction products are dispersed by meterological processes and deposited on vegetation, soils, and surface waters, often at great distances from the source of emissions. Concern has arisen in many countries about effects on forests, fish, crops, water quality, materials, and human health. The result is a growing concern about international exchange of air pollutants, wet and dry deposition of strong acids and other acidifying substances, as well as the associated deposition and mobilization of toxic metals and the leaching of nutrient substances. These concerns developed originally among the Scandinavian countries, Great Britain and Germany, and other industrial nations of central Europe. More recently they have also developed between Canada and the United States. International cooperation between atmospheric scientists and biologists and among leaders of forestry, agricultural, water resource, industrial, and governmental organizations is resulting in a general concensus about both the phenomena involved and strategies for the management of acid deposition. (See also W87-06258) (Author's abstract)
W87-06259

OPTIONS FOR REACHING WATER QUALITY GOALS.
American Water Resources Association, Bethesda, MD.
Proceedings of the Twentieth Annual Conference of the American Water Resources Association Symposium, Washington, DC. August 15, 1984. 1985. 217 p. Edited by Theodore M. Schad.

Descriptors: *Water quality control, *Conferences, *Water pollution sources, *Path of pollutants, Aquifers, Symposium, Fate of pollutants, Groundwater pollution, Surface-groundwater relations.

The papers presented at a symposium on the topics 'Options for Reaching Water Quality Goals' held at the Loews L'Enfant Plaza Hotel in Washington, DC, on August 15, 1984, in connection with the Twentieth Annual Conference of the American Water Resources Association are contained int his volume. The Conference Planning Committee selected the subject of the symposium as an apt corollary to the conference theme: 'Overcoming Institutional and Technical Constraints to Water Resources Management.' The papers discuss the following topics: (1) Institutional and technical aspects of control of pollution from point and nonpoint sources; (2) Monitoring for water quality; (3) Water quality-quantity relationships; (4) Alterna-

tive and innovative technology for pollution abatement; (5) Prevention and cleanup of contaminated underground aquifers; (6) Institutional and technical aspects of controlling groundwater pollution; and (7) Ground water-surface water interrelationships. (See also W87-06271 thru W87-06293) (Lantz-PTT)
W87-06270

PROGRESS ON THE DELAWARE RIVER CLEAN-UP PROGRAM,
Philadelphia Water Dept., PA.
W. J. Marrazzo, and S. Panzitta.
IN: Options for Reaching Water Quality Goals, Proceedings of the Twentieth Annual Conference of the American Water Resources Association Symposium, Washington, DC., August 15, 1984. 1985. p 13-21, 3 fig, 29 ref.

Descriptors: *Delaware River, *Cleanup operations, *Philadelphia, *Water quality control, *Water pollution control, River basins, Delaware River Basin Commission.

This historical perspective on the water quality trends of the Delaware River examines progress on the river cleanup through a period of about 40 years with special reference to Philadelphia's regional contribution to pollution abatement efforts. The value of cooperation via an interstate management agency through which future water quality goals may be achieved is discussed based on the Delaware River Basin Commission's current rate of success in mechanizing cleanup plans. The success of these cooperative efforts is reflected in the present state of the river. Evidence that this section of the river is cleaner is the reported return of the shad whose historic spawning migrations up the river had been blocked for many years by the lack of oxygen. Recent trends of increased DO in the estuary can be primarily attributed to Philadelphia's completion of its Southwest Water Pollution Control Plant. When the City's Southwest and Northeast Plants are commpleted, the overall reduction in BOD discharged by Philadelphia's treatment plants eventually will be 77% from the 330,000 pounds/day in 1978 to 72,000 pounds/day in 1987. Once referred to as a 'mess,' the Delaware River today has 91% of its river miles meeting the 1983 'swimmable' goal and 88% achieving 'fishable' water quality goals. (See also W87-06270) (Lantz-PTT)
W87-06271

GREAT LAKES WATER QUALITY,
Ontario Ministry of the Environment, Toronto.
W. A. Steggles.
IN: Options for Reaching Water Quality Goals, Proceedings of the Twentieth Annual Conference of the American Water Resources Association Symposium, Washington, DC., August 15, 1984. 1985. p 23-29.

Descriptors: *Great Lakes, *Water quality control, *Legislation, *Water pollution control, Canada, Phosphorus, Drinking water, Public policy.

Issues concerning water quality, water quantity and multiple use of water and related land resources are converging in relation to society's claims on these resources. These conflicts are being addressed in a variety of initiatives by Great Lakes juridictions. They range from recent legislative/administrative plans to improved intergovernmental coordination of large scale pollution control and resource development efforts, to individual jurisdictional actions in responding to specific needs. Recent Great Lakes administrative actions highlighted are: (1) The Great Lakes Governors and Premiers resolved to improve and strengthen jurisdictional management of the Great Lakes; (2) Great Lakes environmental administrators act to increase international coordination; (3) Canada and the United States act to improve the development of remedial measures for the Niagara River and other Great Lakes connecting waters; (4) Governments table plans for further phosphorus control; (5) Waste management improvements in Ontario; (6) Ontario presses forward with efforts to improve drinking water quality; and (7) State planning for the 1980's and beyond. Improved intergovernmental coordination and commitment is needed to assure sufficient continuing support for implementing agreement goals. Policies and programs must be continually updated, because of persisting threats from toxic substances and new awareness of the likelihood of a growing scarcity of water supply and growth in demand for these 'great' resources. Perhaps future public policies for use of air, land, and water resources will be guided by the wisdom which led in 1972 to the creation by the two countries of a coordinated plan of attack on Great Lakes pollution. Preparations for revisions of the present agreement are now being made and need to address these major concerns. (Lantz-PTT)
W87-06272

CHESAPEAKE CHALLENGE: RESTORATION AND PROTECTION,
Environmental Protection Agency, Annapolis, MD. Chesapeake Bay Liaison Office.
V. K. Tippie.
IN: Options for Reaching Water Quality Goals, Proceedings of the Twentieth Annual Conference of the American Water Resources Association Symposium, Washington, DC., August 15, 1984. 1985. p 31-39, 6 fig, 4 ref.

Descriptors: *Water quality control, *Chesapeake Bay, *Water pollutioon control, *Path of pollutants, Water pollution sources, Nutrients, Wastewater, Sediment contamination, Bays, Nonpoint source pollution.

The environmental degradation of Chesapeake Bay is described and efforts to restore and protect the Bay are summarized. Scientific studies have confirmed that the Bay's valued living resources have declined due to water and sediment pollution. Increased nutrient loadings from point sources such as sewage treatment plants and nonpoint sources such as agricultural runoff have caused nutrient enrichment problems in many areas of the Bay. High toxic loadings from point sources such as industrial facilities and nonpoint sources such as urban runoff have resulted in sediment toxic contamination in urbanized areas of the Bay. To address these problems, the federal government and the states of Pennsylvania, Maryland, Virginia and the District of Columbia have agreed to support a regional cooperative approach toward Bay management. Accordingly, these jurisdictions have established a regional management structure and have developed implementation plans and programs to improve and protect the water quality and living resources of the Chesapeake Bay. (See also W87-06270) (Author's abstract)
W87-06273

POLICIES FOR CONTROLLING AGRICULTURAL NONPOINT SOURCE POLLUTION,
Conservation Foundation, Washington, DC.
E. H. Clark, and J. A. Haverkamp.
IN: Options for Reaching Water Quality Goals, Proceedings of the Twentieth Annual Conference of the American Water Resources Association Symposium, Washington, DC., August 15, 1984. 1985. p 43-56, 3 tab, 38 ref.

Descriptors: *Public policy, *Water quality control, *Agriculture, *Nonpoint pollution sources, Fate of pollutants, Agricultural runoff, Farm wastes, Evaluation.

Nonpoint sources of water pollution currently account for the majority of conventional pollutants entering America's waterways. These loadings are causing serious water quality problems in some areas (particularly in lakes and estuaries), and are imposing substantial economic costs on the nation. Only in a few instances have effective steps been taken to control this type of pollution. This paper analyzes, from the perspectives of efficiency, equity, environmental quality, and practicability, the various policy issues involved in developing an effective program for controlling loadings from nonpoint agricultural sources. It briefly reviews the techniques that can be used to control such pollution, the policy tools that are availabe to stimulate the adoption of these techinques by farmers, the alternative ways of 'targeting' the expenditure of public and private resources on the lands causing the most serious problems, and various other issues that have to be resolved in developing and implementing an effective agricultural nonpoint source control program. (See also W87-06270) (Author's abstract)
W87-06274

EFFICIENT CONTROL OF AGRICULTURAL SEDIMENT DEPOSITION IN WATER COURSES,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 2J.
W87-06276

OHIO'S SOIL AND WATER CONSERVATION DISTRICTS (SWCDS): CAN THEY FULFILL NONPOINT SOURCE POLLUTION CONTROL RESPONSIBILITIES,
Ohio State Environmental Protection Agency, Columbus. Office of the Planning Coordinator.
J. Mack, and J. Wager.
IN: Options for Reaching Water Quality Goals, Proceedings of the Twentieth Annual Conference of the American Water Resources Association Symposium, Washington, DC., August 15, 1984. 1985. p 77-87, 3 tab, 5 ref.

Descriptors: *Conservation districts, *Water quality control, *Management planning, *Ohio, Soil erosion, Water pollution control, Water conservation, Soil conservation, Nonpoint pollution sources, Water management.

Soil and Water Conservation Districts (SWCDs) are empowered under Section 1515 of the Ohio Revised Code to conduct surveys of soil erosion and sediment; undertake improvements; develop erosion control plans; make rules; and enter agreements with landowners for soil conservation and with the Ohio Department of Natural Resources for agricultural pollution and urban sediment abatement. Because of these powers and the increasing emphasis on nonpoint source pollution control, SWCDs are responsible for implementing portions of Ohio's Water Quality Management (WQM) Plan. Several SWCDs have undertaken federal and state demonstration programs which emphasize water quality/soil conservation measures. However, efforts relied on substantial financial and technical help from federal and state agencies as nearly 15% lack full-time technical staff and only 58% have local appropriations or contributions in excess of $25,000. The SWCDs' ability to carry out Ohio's WQM Plan responsibilities are described, their existing resources and approaches to agricultural and urban sediment pollution abatement are assessed, and necessary actions to improve their role in nonpoint source pollution control are identified. (See W87-06270) (Author's abstract)
W87-06277

STATE/FEDERAL RELATIONSHIPS IN WATER QUALITY MANAGEMENT ON THE NATIONAL FORESTS IN CALIFORNIA,
Forest Service, South Lake Tahoe, CA. Lake Tahoe Basin Management Unit.
A. H. Todd, and J. Rector.
IN: Options for Reaching Water Quality Goals, Proceedings of the Twentieth Annual Conference of the American Water Resources Association Symposium, Washington, DC., August 15, 1984. 1985. p 89-94, 7 fig, 2 ref.

Descriptors: *Standards, *Federal jurisdiction, *State jurisdiction, *California, *Water quality control, Management planning, Forests, Clean Water Act, Legislation.

Much of the water produced in California originates on lands managed by the United States Forest Service (USFS). As a result, the National Forests play an increasing role in providing high quality water for public demands. A framework of cooperative responsibility for control of nonpoint sources of pollution between the USFS and State Water Resources Control Board has been estab-

lished to meet the guidelines of the Clean Water Act (Section 208). A discussion of the institutional setting in which Federal and State planning is conducted, decisions are made, and conflicts are realized or resolved with regard to meeting water quality goals. How Forest Service water quality management guidelines and Best Management Practices are integrated with the review process of the National Environmental Policy Act is also described. (See also W87-06270) (Author's abstract)
W87-06278

POINT AND NONPOINT SOURCE ABATEMENT NEEDS FOR IMPROVING INTERSTATE WATER QUALITY,
Tennessee Valley Authority, Knoxville.
A. M. Duda.
IN: Options for Reaching Water Quality Goals, Proceedings of the Twentieth Annual Conference of the American Water Resources Association Symposium, Washington, DC., August 15, 1984. 1985. p 97-106, 4 fig, 33 ref.

Descriptors: *Water quality control, *Water pollution sources, *Nonpoint pollution sources, *North Carolina, *Tennessee, River basins, Air pollution, Soil erosion, Legislation, Water pollution control.

Progress made in improving water quality during the last 40 years was examined in an interstate river basin draining North Carolina and Tennessee. While dramatic improvements have been achieved in some reaches with the abatement of point source discharges of conventional pollutants, serious water quality problems remain in others, and new sources of pollution - such as deposition of atmospheric pollutants - are causing concern. Nonpoint source pollution is identified as an impediment to the achievement of Clean Water Act goals. A strong Federal presence will be required to overcome institutional constraints in establishing effective, results-oriented Federal/State/local partnerships for pollution abatement. To achieve Clean Water Act goals, especially in interstate waters, the Federal presence must ensure that air pollution control, water pollution control, and land management programs are targeted in an integrated fashion to hot spots of pollution in watersheds with priority water quality problems. (See also W87-06270) (Author's abstract)
W87-06279

SILVICULTURAL NONPOINT SOURCE WATER QUALITY MANAGEMENT UNDER SECTION 208 OF THE CLEAN WATER ACT,
National Council of the Paper Industry for Air and Stream Improvement, Inc., Corvallis, OR.
G. G. Ice.
IN: Options for Reaching Water Quality Goals, Proceedings of the Twentieth Annual Conference of the American Water Resources Association Symposium, Washington, DC., August 15, 1984. 1985. p 107-112, 1 fig, 20 ref.

Descriptors: *Legislation, *Clean Water Act, *Water quality control, *Management planning, *Nonpoint pollution sources, *Silviculture, Forestry, Water pollution control, Monitoring, Regulations.

Since 1979, the National Council of the Paper Industry for Air and Stream Improvement (NCASAI) has been conducting annual surveys of state silvicultural nonpoint source water quality management programs in order to evaluate how these different programs might influence forest-water protection operations. Initial surveys focused on state agencies assessments of the significance of forest operations as contributors to state water quality problems and the types of programs being implemented (voluntary or regulatory). As state silvicultural nonpoint source programs matured, surveys identified in more detail the various types of programs, institutional mechanisms for achieving water quality goals, and initial assessments of program success. There are currently 11 states with regulatory or quasi-regulatory silvicultural nonpoint source control programs and 29 states with either voluntary programs or programs based on agreements between the federal agencies and state water quality agencies. State assessments of Best Management Practice utilization, and nonpoint source control generally indicate an overall success. Circumstances that predispose an operation not to achieve water quality protection goals have also been identified. Both innovative components as well as traditional state forest management elements have been identified which have led to the success of many of the state silvilcultural nonpoint source control programs. (See also W87-06270) (Author's abstract)
W87-06280

CALIFORNIA'S SILVICULTURAL 208 PROGRAM: A VIEW FROM THE TIMBER INDUSTRY,
Simpson Timber Co., Arcata, CA. California Operations.
A. E. Skaugset.
IN: Options for Reaching Water Quality Goals, Proceedings of the Twentieth Annual Conference of the American Water Resources Association Symposium, Washington, DC., August 15, 1984. 1985. p 113-120, 2 fig, 8 ref.

Descriptors: *Management planning, *Forestry, *California, *Silviculture, *Clean Water Act, *Water quality control, Planning, Watersheds, Watershed management.

For the past six years California has been working on its silvilcultural area-wide waste treatment management plan as mandated by Section 208 of the Federal Clean Water Act. The State Water resources Control Board which was designated as the lead agency in California for 208 planning completed the 208 planning process in three phases. Phase I was a review of the existing Forest Practices Act and Rules and was contracted to the Board of Forestry. Phases II and III were mapping projects involving geologic landform mapping in selected watersheds along the North Coast. These projects were contracted to the Department of Water Resources and the Department of Forestry, respectively. The Phase I project resulted in a rewrite of the Forest Practice Rules which were put into effect in October 1983 and certified in June 1984 as Best Management Practices for at least the next four years. The Phase II and III projects resulted in a spin-off California Department of Forestry Watershed Mapping Project which will map 'geologic features related to landsliding' for essentially all the private commerical timberland in the Coast District. (See also W87-06270) (Author's abstract)
W87-06281

ILLINOIS' PROCESS TO IDENTIFY, SCREEN AND PRIORITIZE RURAL WATER RESOURCE AND LAKE REHABILITATION PROJECTS,
Environmental Protection Agency, Chicago, IL. Region V.
T. E. Davenport.
IN: Options for Reaching Water Quality Goals, Proceedings of the Twentieth Annual Conference of the American Water Resources Association Symposium, Washington, DC., August 15, 1984. 1985. p 121-127, 4 fig, 2 tab.

Descriptors: *Illinois, *Water pollution sources, *Lakes, *Lake rehabilitation, *Water quality control, *Management planning, Rural areas, Soil erosion, Sedimentation, Monitoring.

Initial water quality management planning efforts within Illinois documented that the most severe agriculturally related problem was soil erosion resulting in lake sedimentation. Within the State a uniform process to identify, screen, and prioritize rural water resources and lake rehabilitation projects was developed to target available financial and technical resources. The process provides a uniform and systematic method for local Soil and Water Conservation Districts, Agricultural Stabilization and Conservation Service County Committees and other local units of government to identify and compete for funding under PL 83-556 and Agricultural Conservation Program. Designed to set meaningful State priorities, the system provides equal access for each project to all the available program authorities and gives the local county responsibility for identifying and prioritizing its projects. The process has been successful to date. (See also W87-06270) (Author's abstract)
W87-06282

EFFICIENCY OF ROADSIDE SWALES IN REMOVING HEAVY METALS FROM HIGHWAY ASSOCIATED NONPOINT SOURCE RUNOFF,
University of Central Florida, Orlando. Dept. of Civil Engineering and Environmental Sciences.
H. H. Harper, Y. A. Yousef, and M. P. Wanielista.
IN: Options for Reaching Water Quality Goals, Proceedings of the Twentieth Annual Conference of the American Water Resources Association Symposium, Washington, DC., August 15, 1984. 1985. p 129-137, 5 fig, 5 tab, 4 ref.

Descriptors: *Swales, *Nonpoint pollution sources, *Water quality control, *Orlando, *Florida, *Path of pollutants, *Roads, Heavy metals, Surface runoff, Water pollution control, Storm water, Hydrogen ion concentration.

One of the most common management techniques for highway runoff is the roadside swale. These swale systems are usually designed as a conveyance mechanism for transporting runoff from the roadway to the receiving water body. However, little information has been collected on the efficiency of these swale systems in reducing pollutant concentrations. Therefore, a series of controlled experiments were designed and conducted to investigate the fate of nutrients and heavy metals discharged to swale areas located at two sites in the Orlando area. Runoff water from adjacent retention ponds was dosed with various concentrations of nutrients and heavy metals, such as lead, zinc and chromium, and pumped continuously into the swale test areas, ranging in length from 53 to 170 m. Samples of the swale flow were collected at various distances along the flow path at specified time intervals for a period of 4-6 hours. Concentrations of heavy metals and nturients were measured and removal efficiencies were quantified. Removal of heavy metals was found to be closely associated with the pH of the runoff water and the corresponding chemical speciation of the metal ions. Heavy metals which existed at the test pH as a free metal ion were removed to a much larger degree than metals which existed predominantly as an uncharged ion or as an ion with a diffused charge. The presence of organic complexing agents, such as humic acid, reduced the removal efficiency considerably. The removal of phosphorus was much less than that observed for heavy metals. Concentrations of nitrogen forms were not changed to any significant degree during passage through the swale area. (See also W87-06270) (Author's abstrat)
W87-06283

EVALUATION OF SOME REAL-TIME TECHNIQUES FOR CONTROLLING COMBINED SEWER OVERFLOWS,
Quebec Univ., Montreal. Dept. of Physics.
P. Beron, F. Briere, J. Rousselle, and J. P. Riley.
IN: Options for Reaching Water Quality Goals, Proceedings of the Twentieth Annual Conference of the American Water Resources Association Symposium, Washington, DC., August 15, 1984. 1985. p 139-145, 4 fig, 2 tab, 6 ref.

Descriptors: *Water quality control, *Overflow, *Wastewater management, *Storm-overflow sewers, Storm water, Drainage systems, Simulation analysis, Sewer systems, Storm sewers, Model studies.

Five strategies for the real-time control of combined sewer overflows during storm events were compared. These strategies are: simple local control, local automatic control, centralized volume control, centralized loads control, and centralized weighted loads control. Comparisons were made by simulating a hypothetical watershed and urban drainage system. This procedure was adopted to avoid assembling the large database needed for the calibration and operation of the models for an actual urban area. The study shows that the most

effective control strategy is the relatively simple local automatic control. (See also W87-06270) (Lantz-PTT)
W87-06284

RIVER BASIN WATER QUALITY MONITORING NETWORK DESIGN,
Old Dominion Univ., Norfolk, VA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7A.
W87-06285

WATER QUALITY MAPPING WITH SIMULATED LANDSAT THEMATIC MAPPER DATA,
Ames Lab., IA.
For primary bibliographic entry see Field 7B.
W87-06286

USE OF AERIAL PHOTOGRAPHY IN DETECTION AND CHARACTERIZATION OF NONPOINT SOURCES OF POLLUTION,
Environmental Photographic Interpretation Center, Warrenton, VA.
For primary bibliographic entry see Field 7B.
W87-06287

WATER QUALITY MONITORING FOR THE TACHIA RIVER IN TAIWAN, REPUBLIC OF CHINA,
Ministry of Economic Affairs, Taipei (Taiwan). Water Resources Planning Commission.
For primary bibliographic entry see Field 7B.
W87-06288

GROUND WATER AND UNDERGROUND TANKS: PAST PROBLEMS AND PRESENT SOLUTIONS,
ICF, Inc., Washington, DC.
For primary bibliographic entry see Field 5E.
W87-06289

CONTROLLING GROUND WATER POLLUTION FROM SEWAGE EFFLUENT DISPOSAL IN THE TUCSON AREA,
Pima County Dept. of Wastewater Management, Tucson, AZ.
D. M. Esposito, and K. D. Schmidt.
IN: Options for Reaching Water Quality Goals, Proceedings of the Twentieth Annual Conference of the American Water Resources Association Symposium, Washington, DC., August 15, 1984. 1985. p 189-192, 1 fig, 2 tab, 8 ref.

Descriptors: *Groundwater pollution, *Water quality control, *Wastewater disposal, *Tucson, *Arizona, *Water pollution control, Effluents, Path of pollutants, Organic compounds.

Sewage effluent in the Tucson area was sampled for trace organic constituents. Effluent derived from primarily residential sources in the Green Valley area contained no significant levels of the trace organics analyzed. Effluent in the metropolitan area, which is derived from areas containing significant industrial discharges, also contained no significant levels of these trace organics. In the metropolitan treatment plants, conventional secondary treatment through biofiltration and activated sludge resulted in signficant reductions in levels of trace organics, particularly volatiles. Effluent disposal was achieved through percolation ponds in the Green Valley area and by discharge to a normally dry stream in the metropolitan area. Groundwater in neither area was degraded beyond drinking water limits, however there are presently no drinking water limits for trace organics. (See also W87-06270) (Author's abstract)
W87-06290

DEVELOPMENT OF INTEGRATED SURFACE AND GROUND WATER MANAGEMENT IN ILLINOIS,
Illinois State Environmental Protection Agency, Springfield. Div. of Land Pollution Control.
For primary bibliographic entry see Field 4B.
W87-06291

CHEMICAL ENGINEERING TREATMENTS FOR CONTAMINATED GROUND WATER,
NUS Corp., Houston, TX.
R. G. Fessler, B. P. Popkin, and E. Fromm.
IN: Options for Reaching Water Quality Goals, Proceedings of the Twentieth Annual Conference of the American Water Resources Association Symposium, Washington, DC., August 15, 1984. 1985. p 201-206, 3 tab, 5 ref.

Descriptors: *Groundwater pollution, *Water pollution treatment, *Chemical treatment, *Waste disposal, Aquifers, Wastewater management, Separation techniques, Reverse osmosis, Ion exchange, Chemical precipitation.

As a result of the Resource Conservation and Recovery Act (RCRA, 1976) and the Comprehensive Environmental Response, Compensation and Recovery Act (CERCLA, 1980), industrial site owners, and state and federal agencies are assessing groundwater quality and cleaning up serious groundwater contamination. Many people have chosen to contain contamination on site with slurry walls or by pumping, or to remove contamination for long-term storage in landfills or deep geologic formations. Chemical engineering technology exists to treat or detoxify contaminated groundwater under certain conditions. Chemical engineering treatments may be possible if the contaminated groundwater plume is known, with respect to its chemistry and extent, and if the aquifer is pumpable. Selected treatments include separation technology for organics, and ion exchange/molecular sieves/reverse osmosis and precipitation/sedimentation for metals. Separation and treatment technology includes distillation (steam stripping), carbon adsorption, and specialized biodegradation systems. This paper reviews selected chemical engineering treatments, their technology and applicability, and their relative costs. (See also W87-06270) (Author's abstract)
W87-06292

AQUIFER PROTECTION PLANS: PREVENTING CONTAMINATION OF LOCAL PUBLIC WATER SUPPLIES,
Lexington-Fayette Urban County Government, KY. Dept. of Public Works.
S. M. Kilner.
IN: Options for Reaching Water Quality Goals, Proceedings of the Twentieth Annual Conference of the American Water Resources Association Symposium, Washington, DC., August 15, 1984. 1985. p 207-215, 3 fig, 3 tab, 13 ref.

Descriptors: *Water quality control, *Aquifers, *Groundwater pollution, *Public waters, *Water pollution control, Water supply, Management planning, New England.

Discoveries of toxic contaminants in public water supplies receive wide publicity and often arouse public alarm. Citizens blame local officials for permitting a contaminant source to locate near a wellfield. Effective local groundwater protection requires coordination among many municipal agencies including Water Superintendents, Boards of Health, Planning Boards, Fire Departments and Departments of Public Works. Local officials can take the initiative in protecting valuable aquifers by preparing an Aquifer Protection Plan. An Aquifer Protection Plan identifies potential contaminant sources, reviews existing municipal practices, outlines protection strategies and provides necessary supporting information for the various municipal agencies responsible for its implementation. A local institutional approach to controlling groundwater pollution is described and experiences of three New England communities which have adopted Aquifer Protection Plans are related. (See also W87-06270) (Author's abstract)
W87-06293

HEAVY METALS IN NATURAL WATERS: APPLIED MONITORING AND IMPACT ASSESSMENT,
Alberta Environmental Centre, Vegreville.
For primary bibliographic entry see Field 5B.
W87-06295

RESTORATION OF RIVERS AND STREAMS: THEORIES AND EXPERIENCE.
Butterworth Publishers, Boston, Massachusetts. 1985. 280 p. Edited by James A. Gore.

Descriptors: *River restoration, *Stream restoration, *Water quality control, History, Literature review, Reviews.

Previous efforts on the restoration of rivers and streams are reviewed, and a selection of restoration ideas and alternatives are the stream manager are presented. Either through case histories or specific techniques, chapters attempt to address these restoration points: (1) what historical practices and successes there have been; (2) new or additional techniques being used in recent restoration projects; (3) new techniques more successful than the 'old stand-by'; and (4) how the techniques can be integrated into an overall recovery enhancement project. Reference sections for each chapter provide an extensive library of additional works for consultation. (See also W87-06436 thru W87-06444)(Lantz-PTT)
W87-06435

WATER QUALITY RESTORATION AND PROTECTION IN STREAMS AND RIVERS,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
E. E. Herricks, and L. L. Osborne.
IN: The Restoration of Rivers and Streams: Theories and Experience, Butterworth Publishers, Boston, Massachusetts. 1985. p 1-20, 1 fig, 3 tab, 40 ref.

Descriptors: *Stream restoration, *River restoration, *Water quality control, Streams, Rivers, Water quality management, Isolation, Water transfer, Water pollution control, Water pollution sources.

Restoration and protection of stream quality are concepts basic to the formulation of water quality regulation in the United States. In practice, the goal of both restoration and protection is the return to, or maintenance of, some preconceived notion of an undisturbed state. Since few undisturbed streams and rivers exist, arbitrary measures of restoration effectiveness are often based on readily accepted criteria and standards of water quality. The success of restoration and protection efforts and the applicability of any technique or methodology that restores water quality or protects existing uses is dependent on physical, chemical, and biological characteristics of the stream ecosystem and prevailing use and disturbance in each watershed. Assessment of restoration and protection is dependent on the scientific validity of the criterion value used as an endpoint. Protection and restoration of stream water quality requires a knowledge, appreciation, and proper juxtaposition of several fields of science. The primary methods of restoration are isolation, removal, transfer, and dilution through space and time of substances which degrade water quality or affect ecosystem structure and function. Protection of stream water quality is often technology based. The application of treatment technologies typically meets protection requirements where point sources of effluents, containing high concentrations of substances that degrade water quality, are encountered. The potential for water quality degradation from nonpoint sources is greater (entire watersheds may be involved), but substance concentrations are generally less than point source effluents. Protection of stream water quality affected by nonpoint sources of pollution is dependent on the implementation of best management practices that control substance entry into stream systems. (See also W87-06435)(Lantz-PTT)
W87-06436

USE OF MEANDER PARAMETERS IN RESTORING HYDROLOGIC BALANCE TO RECLAIMED STREAM BEDS,

Wyoming Univ., Laramie. Dept. of Civil Engineering.
V. R. Hasfurther.
IN: The Restoration of Rivers and Streams: Theories and Experience, Butterworth Publishers, Boston, Massachusetts. 1985. p 21-40, 5 fig, 1 tab, 36 ref.

Descriptors: *Meanders, *Hydrologic budget, *Stream beds, *Water quality control, Geomorphology, Erosion, Sedimentation, Channel improvement, Stream profiles.

Most streams are continually changing position and shape as a consequence of hydraulic forces acting on their beds and banks. This stress is mainly a result of climatic changes from year to year in the amount of water flow variation that occurs in the stream. It is the rule rather than the exception that banks will erode, sediments will be deposited, and floodplains, islands, etc., will undergo change with time. The problem in all this comes when humans induce change upon the system without taking the necessary steps to restore the quasi-steady situation and thus, set in motion a response by the stream system to adjust to this change, which results in the propagated response along great distances from the human-induced action. In planning and designing stream channel restoration and stream system balance, it is critically important to avoid the geometric stress thresholds of a stream at which dramatic and significant undesirable landscape modifications occur. It is desirable to approximate a range of appropriate stream channel features that will cause the stream system to respond to its natural inclinations (the stream pattern which would exist under normal conditions) as if no human action had occurred. This intervention will result in controlled sediment production and produce a channel similar to the existing stream channel. The end result will be a system where stream habitat should be equivalent to predisturbance and, hopefully, a slight enhancement of habitat and form. This chapter discussed methods and techniques for restoring a stream channel to its natural inclinations after a human-induced change such as surface mining, road construction, etc. The main emphasis will be on meander parameters and their importance in stream channel stability. (See also W87-06435) (Lantz-PTT)
W87-06437

RIPARIAN REVEGETATION AS A MITIGATING PROCESS IN STREAM AND RIVER RESTORATION,

Arizona State Univ., Tempe. Center for Environmental Studies.
B. W. Anderson, and R. D. Ohmart.
IN: The Restoration of Rivers and Streams: Theories and Experience, Butterworth Publishers, Boston, Massachusetts. 1985. p 41-79, 11 fig, 13 tab, 21 ref. Bureau of Reclamation Contract No. 1-07-34-X0176.

Descriptors: *Riparian vegetation, *Stream restoration, *Rainfall-runoff relationships, *River restoration, Phreatophytes, Water quality control, Vegetation, Aquifers, Watersheds, Riparian waters, Rainfall impact.

Riparian vegetation is frequently termed phreatophytic, denoting a collective group of plant species that have their roots located in perennial groundwater or in the capillary fringe above the water table. The term has a negative connotation among water managers and refers to those plant species which transpire large quantities of water from the water table. Consequently, phreatophytes are frequently perceived as undesirable and their removal has been viewed as positive because it constitutes water salvage or a reduction in water loss from underground aquifers. In general, the amount and type of vegetational ground cover, the areal extent of the watershed, and the slope of the terrain are directly related to the percentage of water that will enter the drainage system as surface flow, or as percolated water. Good watersheds have a high roughness coefficient which implies a good covering of perennial grasses. The force of falling raindrops is reduced before hitting the soil, and the vegetation retards the flow of the surface water, allowing more time for the water to penetrate the soil. This slower, decreased surface water flow reduces the erosion of topsoil and mitigates the severity of flooding. Summarized here are the results of field studies of riparian habitats on the lower Colorado River, and efforts to develop from field-collected data plant community designs that would house as many vertebrate species as possible and support high densities of wildlife. (See also W87-06435) (Lantz-PTT)
W87-06438

MECHANISMS OF COLONIZATION AND HABITAT ENHANCEMENT FOR BENTHIC MACROINVERTEBRATES IN RESTORED RIVER CHANNELS,

Tulsa Univ., OK. Faculty of Natural Sciences.
J. A. Gore.
IN: The Restoration of Rivers and Streams: Theories and Experience, Butterworth Publishers, Boston, Massachusetts. 1985. p 81-101, 7 fig, 80 ref.

Descriptors: *River channels, *River restoration, *Benthic environment, *Macroinvertebrates, Ecosystems, Streams, Rivers, Sediments, Colonization.

The restoration of stable and viable benthic macroinvertebrate communities is an integral component of the effective restoration of a stream or river ecosystem. It is a particularly critical component if the benthos are known to supply a major portion of the food base for fish populations of the system. Of all the requirements for reclamation and restoration of lotic ecosystems, benthic community restoration and recovery required the smallest amount of capital investment and least sophisticated of special structure development. The benefits to maintenance of higher trophic levels in the systems are well worth that investment. Only a few procedures need be followed: (1) measurement and placement of substrate similar to the undisturbed source area of invertebrate colonizers; (2) placement of structures to control increased sediment loads; (3) placement of structures to ensure maintenance of stable and productive riffle areas; 4) monitoring of benthic recolonization; and (5) assessment of restoration success by demonstration of stable communities similar to those in adjacent undisturbed source areas. (See also W87-06435) (Lantz-PTT)
W87-06439

STREAM CHANNEL MODIFICATIONS AND RECLAMATION STRUCTURES TO ENHANCE FISH HABITAT,

Wyoming Univ., Laramie. Water Resources Research Inst.
For primary bibliographic entry see Field 6G.
W87-06440

METHODS FOR DETERMINING SUCCESSFUL RECLAMATION OF STREAM ECOSYSTEMS,

Brigham Young Univ., Provo, UT. Dept. of Zoology.
For primary bibliographic entry see Field 6G.
W87-06441

AQUATIC COMMUNITY RESPONSE TO TECHNIQUES UTILIZED TO RECLAIM EASTERN U.S. COAL SURFACE MINE - IMPACTED STREAMS,

Tennessee Valley Aut'ority, Knoxville.
For primary bibliographic entry see Field 5C.
W87-06442

SOME EFFECTS OF STREAM HABITAT IMPROVEMENT ON THE AQUATIC AND RIPARIAN COMMUNITY OF A SMALL MOUNTAIN STREAM,

Marsan (Andre) et Associes, Inc., Montreal (Quebec).
S. A. Burgess.
IN: The Restoration of Rivers and Streams: Theories and Experience, Butterworth Publishers, Boston, Massachusetts. 1985. p 223-246, 2 fig, 2 tab, 24 ref.

Descriptors: *Ecosystems, *Streams, *Aquatic habitats, *Stream improvement, Riparian waters, Mountain streams, Trout, Streamflow, Pools, Crayfish.

To test the value of habitat improvement as a means of increasing trout biomass, a section of the study stream (an unnamed, spring-fed mountain stream) that divided to form two parallel sections of approximately 100 m in length was selected for study. One section was selected for habitat improvement, while the other was left unmanaged and served as a control. To ensure control of discharge through the two sections, flow control structures were constructed at the head of each. As a result, flows through the two sections could be equalized, or flow through one section could be cut off completely to allow the collection of fish and crayfish from the drained section. Habitat improvement in the study area involved the construction of small rock dams and deflectors. Before habitat improvement, less than 10% of the stream channel consisted of pools. Afterward, the riffle:pool ratio in the improved section was approximately 1:1. In-stream cover, in the form of logs, as well as rafts of alders lashed together, was introduced into the improved section, usually in pools and near areas of high food availability. This study demonstrated that in addition to increasing trout biomass, stream habitat improvement also affected populations of nontarget organisms. Crayfish populations increased substantially in the improved section, which likely resulted in the increased use of that area by mink and raccoons. In this case, no significant loss of trout biomass occurred as a result of increased use of the area by mammalian predators. In areas where no alternate prey species are available, some trout might be lost as a result of predation. It is unlikely, however, that predation by mink would negate the value of habitat improvement as a management tool. The management techniques employed in this study had several advantages. The structures were simple to build, using readily available materials. Labor requirements were low and all work was accomplished using hand tools. As a result, the total cost of habitat improvement was relatively low. In addition, because they were constructed of materials available on site, the structures preserved the natural aspect of the stream. This is an important consideration, since preserving the natural or aesthetic quality of the environment is often critical to maintaining the overall enjoyment of the angling experience. (See also W87-06435) (Lantz-PTT)
W87-06443

ENHANCEMENT OF URBAN WATER QUALITY THROUGH CONTROL OF NONPOINT SOURCE POLLUTION: DENVER, COLORADO,

Engineering-Science, Inc., Denver, CO.
R. D. Judy.
IN: The Restoration of Rivers and Streams: Theories and Experience, Butterworth Publishers, Boston, Massachusetts. 1985. p 247-279, 9 fig, 5 tab, 24 ref.

Descriptors: *Water quality control, *Water pollution control, *Nonpoint pollution sources, *Denver, *Colorado, South Platte River, Surface runoff, Urban runoff, Model studies.

Techniques were developed to quantify pollutant loadings in the South Platte River, Denver, Colorado, resulting from storm event generated nonpoint source pollution. Nonpoint source pollution is defined as pollution originating from many different sources, such as streets, parking lots, industrial and residential developments, atmospheric deposition, etc. Nonpoint source pollution is not presently governed by the National Pollution Discharge Elimination System or any type of wet weather water quality criteria. The data show that the relationships between storm rainfall, runoff, effective impervious area, and pollutants are quantifiable. Urban runoff pollution is probably predictable, with these predictions based on the model presented here. The model itself requires careful testing, evaluation, and revision for other than conservative constituents. The results of the actual

testing as well as testing by others in different geographical areas is necessary to determine its applicability to a wide variety of conditions. Predictive results of the model utilizing Best Management Practices data and data from the special studies may have serious implications for the future of water quality management. These implications include implementation of a Best Management Practices program in conjunction with the NPDES program. Also, wet weather quality criteria that are in developmental stages may greatly impact state water quality standards and practice. This study is a step in determining the answers to these and other possible questions. (See also W87-06435) (Lantz-PTT)
W87-06444

LAKE AND RESERVOIR RESTORATION,
Kent State Univ., OH. Dept. of Biological Sciences.
G. D. Cooke, E. B. Welch, S. A. Peterson, and P. R. Newroth.
Butterworth Publishers, Boston, Massachusetts. 1986. 392 p, 77 fig, 34 tab, 791 ref.

Descriptors: *Eutrophication, *Lake restoration, *Case studies, *Ecological effects, Ecosystems, Wastewater treatment, Hypolimnion, Chemical precipitation, Phosphorus, Sediments, Aeration.

The eutrophication process and the development of a pre-restoration diagnosis and feasibility study in a simplified but easily understood manner are described. Chapters on various restoration methods (such as advanced treatment and diversion of wastewater and stormwater, hypolimnetic withdrawal, dilution and flushing, phosphorus precipitation and inactivation, sediment oxidation, sediment removal, hypolimnetic aeration) include an introduction to the theory of the problem and the restoration technique, a description of application procedures, an analysis of case studies and success stories, and a discussion of costs and potential negative impacts. The chapters contain extensive bibliographies, making them suitable not only to the person interested in the actual implementation of a method, but also to those who are entering the field and learning about the problems and management of lakes and reservoirs. (Lantz-PTT)
W87-06446

WATER RESOURCES PLANNING,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W87-06448

GROUNDWATER QUALITY AND MANAGEMENT: RESEARCH AND EXTENSION.
Cornell Univ. Agricultural Experiment Station, Ithaca, NY.
Draft Report III, December 1985. 58 p, 6 tab, append.

Descriptors: *Groundwater management, *Groundwater quality, *Water quality control, Water supply, Groundwater availability, Agriculture, Research priorities.

America's groundwater is fifty times as plentiful as water in its rivers and lakes. Groundwater is a source of drinking water for approximately one-half the nation's population. Groundwater also provides about 40% of the nation's irrigation requirements and about 80% of rural water needs, both in the home and for livestock. Few doubt that contamination of groundwater is a growing problem. The impact of agricultural activities on groundwater quality and quantity is an issue of major national importance. Proper management of agricultural systems to maintain acceptable groundwater quality is increasing in importance. Research efforts need to be focused on physical, chemical and biological processes that influence groundwater quality. This proposal presents a comprehensive research and extension plan to sustain agricultural productivity and protect groundwater resources for rural areas. The goal is provision of an adequate quantity of acceptable quality groundwater. Current research in groundwater within State Agricultural Experiment Stations and within federal and other agencies is inadequate to meet existing needs for research and extension. There is an immediate need for increased research on source and prevention, fate, remedial (corrective), and impact and institutional issues. Example research programs to address these major issues are given. Technology transfer through Cooperative Extension is proposed to transmit benefits of research investments to the public. Issues of training and numbers of personnel are key constraints to Extension's programming in groundwater quality. Funding for fundamental research and extension programs in groundwater quality must be added to existing limited resources. USDA funding of $55 million/yr for research grants, fellowships, equipment and facilities grants, and extension grants is proposed to accomplish the goal of clean groundwater. (Lantz-PTT)
W87-06451

ECONOMIC IMPACT OF PROPOSED REGULATION R81-19 FOR SITE-SPECIFIC WATER POLLUTION RULES APPLICABLE TO CITIZENS UTILITIES COMPANY DISCHARGE TO LILY CACHE CREEK.
Ducharme (Robert G.), Inc., Deerfield, IL.
Available from the National Technical Information Service, Springfield, VA. 22161 as PB84-243369. Document No. 82/19, June 1982. 102 p, 8 tab, 62 ref, 3 append. Project No. 80.261.

Descriptors: *Water quality control, *Regulations, *Public policy, *Lily Cache Creek, *Illinois, *Utilities, Water pollution prevention, Fishing, Economic aspects, Social participation, Public participation, Recreation.

This economic impact study concerns a petition for site specific water pollution rules and regulations for West Suburban Treatment Plant No. 1 (WSB No.1) in the Village of Bolingbrook, owned and operated by Citizens Utilities Company of Illinois. Effluent ammonia nitrogen (NH3-N) concentrations must be limited to a level that will not cause the receiving stream to exceed the standard of 1.5 mg/L except during the months of November through March when the standard is 4.0mg/L. Since Lily Cache Creek is an intermittent stream with an historical average 7-day, 10-year low flow of zero, the water quality standards are in effect the effluent standards. WSB No.1 has operated under variances granted by the Illinois Pollution Control Board on July 20, 1978 and on March 5, 1981 providing for effluent discharge limits of 20 mg/L for BOD5, 25 mg/L for TSS and up to 15 mg/L for NH3-N. The current variance extends to July 1, 1985 and was granted on condition that design, engineering, and construction be established on a schedule that would allow total compliance with the NPDES effluent limitations before July 2, 1985. During the most recent variance proceeding Citizens expressed its intention to petition for a site specific regulation incorporating on a permanent basis the 20/25/15 effluent standards allowed in the variance. That petition was in fact filed on June 12, 1981 and is the object of this study. Lily Cache Creek is not suitable for water contact recreation such as swimming and water skiing. Fishing (including natural resource protection) is the only Creek use affected by the proposal. Approval of the proposal would result in an annual loss of 2,972 sport fishing opportunities in Lily Cache Creek and the DuPage River valued at approximately $52,000/yr. The cost of constructing the facilities required to upgrade WSB No.1 is $3,626,000. Annual operation and maintenance costs related to these new facilities are estimated at $223,000. Capital costs were projected to November 1984, the expected midpoint of construction and operation and maintenance costs were projected to the third quarter of 1985, the anticipated time the facilities would become operational. The annualized cost related to upgrading the plant including depreciation capital service, income taxes, and operation and maintenance expenses totals $1,340,148/yr. (Lantz-PTT)
W87-06454

SYMPOSIUM ON TROPICAL HYDROLOGY AND 2ND CARIBBEAN ISLANDS WATER RESOURCES CONGRESS.
American Water Resources Association, Bethesda, MD.
For primary bibliographic entry see Field 2A.
W87-06455

RUNOFF DISPOSAL IN THE LIMESTONE REGION OF NORTHERN P.R.,
Geotec, Caparra Heights, PR.
For primary bibliographic entry see Field 4A.
W87-06461

AUTOMATED PROCEDURE FOR MONITORING THE EFFECTIVENESS OF OZONATION PROCESSES,
Centre de Recherche Lyonnaise des Eaux - Degremont, Le Pecq (France).
For primary bibliographic entry see Field 5D.
W87-06515

CONTROL OF A FULLY AUTOMATED OZONE APPLICATION SYSTEM,
Hankin Environmental Systems, Scarborough (Ontario).
For primary bibliographic entry see Field 5F.
W87-06516

AUTOMATION OF A PLANT TREATING WATER WITH OZONE,
Societe Degremont, Rueil-Malmaison (France).
For primary bibliographic entry see Field 5D.
W87-06517

ASSESSMENT OF RESERVOIR MIXING PROCESSES,
Ford, Thornton, Norton and Associates Ltd., Little Rock, AR.
For primary bibliographic entry see Field 2H.
W87-06523

WATER QUALITY, MACROINVERTEBRATES, LARVAL FISHES, AND FISHES OF THE LOWER MISSISSIPPI RIVER - A SYNTHESIS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 2H.
W87-06526

WETLANDS AND WATER QUALITY: A REGIONAL REVIEW OF RECENT RESEARCH IN THE UNITED STATES ON THE ROLE OF FRESHWATER AND SALTWATER WETLANDS AS SOURCES, SINKS, AND TRANSFORMERS OF NITROGEN, PHOSPHORUS, AND VARIOUS HEAVY METALS,
Rhode Island Univ., Kingston. Graduate School of Oceanography.
For primary bibliographic entry see Field 2L.
W87-06529

EDUCATIONAL INTERVENTION FOR ALTERING WATER-SANITATION BEHAVIORS TO REDUCE CHILDHOOD DIARRHEA IN URBAN BANGLADESH: I. APPLICATION OF THE CASE-CONTROL METHOD FOR DEVELOPMENT OF AN INTERVENTION,
International Centre for Diarrheal Disease Research, Dacca (Bangladesh).
J. D. Clemens, and B. F. Stanton.
American Journal of Epidemiology AJEPAS, Vol. 125, No. 2, p 284-291, February 1987. 6 tab, 15 ref.

Descriptors: *Water use, *Sanitation, *Diarrhea, *Human diseases, *Water-sanitation behavior, *Infection, *Bangladesh, *Education, Urban sociology, Statistical analysis, Comparison studies, Diseases, Food habits, Domestic wastes, Wastes, Bacteria.

A case-control study was performed to develop an empirically based intervention for improving water-sanitation practices and rates of childhood diarrhea among families residing in urban Bangladesh. For three months fortnightly histories of diarrhea were taken for all children under six years

of age among 1,350 families to estimate age-specific rates of diarrhea in the population. A total of 247 randomly sampled families were visited once during the study for prolonged observations of water-sanitation practices. Behaviors potentially affecting incidence of diarrhea were compared in a case group whose children had rates at least 1.7 times the rates expected for similarly aged children, and in a control group without any episodes of childhood diarrhea during the period of observation. Three practices differentiated the two groups: more control (82%) than case (53%) mothers who were observed to prepare food washed their hands before beginning the preparation; fewer control families (33%) than case families (80%) had ambulatory children who, when observed to defecate, did so in the family's living area; and fewer control (30%) than case (47%) families had children who were observed to place garbage or waste products in their mouth. Focus on these three empiric associations enabled the design of a community-specific educational intervention which is simple in construction and based upon naturally occurring, financially feasible, salutory practices. (See also W87-06542) (Author's abstract)
W87-06541

EDUCATIONAL INTERVENTION FOR ALTERING WATER-SANITATION BEHAVIORS TO REDUCE CHILDHOOD DIARRHEA IN URBAN BANGLADESH: II. A RANDOMIZED TRIAL TO ASSESS THE IMPACT OF THE INTERVENTION ON HYGIENIC BEHAVIORS AND RATES OF DIARRHEA,
International Centre for Diarrheal Disease Research, Dacca (Bangladesh).
B. F. Stanton, and J. D. Clemens.
American Journal of Epidemiology AJEPAS, Vol. 125, No. 2, p 292-301, February 1987. 4 tab, 18 ref.

Descriptors: *Water-sanitation behavior, *Water use, *Sanitation, *Diarrhea, *Human diseases, *Infection, *Bangladesh, *Education, Urban sociology, Diseases, Statistical analysis, Behavior, Comparison studies, Food habits, Domestic wastes, Wastes, Bacteria, Case studies, Epidemiology, Developing countries.

An educational intervention was designed to improve three water-sanitation behaviors empirically shown to be associated with high rates of childhood diarrhea in Dhaka, Bangladesh: lack of handwashing before food preparation, open defecation by children in the family compound, and inattention to proper disposal of garbage and feces, increasing the opportunity for young children to place waste products in their mouth. Fifty-one communities, each comprising 38 families, were randomized either to receive or not to receive the intervention. During the six months after the intervention, the rate of diarrhea (per 100 person-weeks) in children under six years of age was 4.3 in the intervention communities and 5.8 in the control communities (26% protective efficacy). A corresponding improvement in handwashing practices before preparing food was noted, although no improvement was observed for defecation and waste disposal practices. These data suggest that educational interventions for waste-sanitation practices can have an important beneficial effect upon childhood diarrhea in developing countries, particularly when the interventions are designed in a simple way to promote naturally occurring salutory behaviors that are empirically associated with lower rates of childhood diarrhea. (See also W87-06541) (Author's abstract)
W87-06542

PREVENTION OF FORMATION OF ACID DRAINAGE FROM HIGH-SULFUR COAL REFUSE BY INHIBITION OF IRON- AND SULFUR-OXIDIZING MICROORGANISMS. I. PRELIMINARY EXPERIMENTS IN CONTROLLED SHAKEN FLASKS,
Ohio State Univ., Columbus. Dept. of Microbiology.
P. R. Dugan.
Biotechnology and Bioengineering BIBIAU, Vol. 29, No. 1, p 41-48, January 1987. 11 fig, 22 ref. DOI Grant 14-34-001-8109.

Descriptors: *Acid mine drainage, *Mine drainage, *Coal mining, *Mine wastes, *Coal mining, *Acids, *Water pollution control, *Inhibition, *Bacteria, Microbial oxidation, Hydrogen ion concentration, Pollutants, Oxidation, Chemical reactions, Microorganisms, Iron, Sulfur, Sulfates, Slurries, Pyrite.

Acid formation that results from exposure of pyritic minerals, discarded in the process of coal mining, to the combined effects of atmospheric oxygen, moisture, and a group of acidophilic iron- and sulfur-oxidizing bacteria is a major environmental problem. Changes of pH and sulfate concentration in high-sulfur coal refuse slurries are used as measurements of microbial pyrite oxidation in the laboratory. Sodium lauryl sulfate (SLS), alkylbenzene sulfonate (ABS), benzoic acid (BZ) and combinations of SLS plus BZ and ABS plus BZ effectively inhibited formation of sulfate and acid when added in concentrations greater than 50 mg/l to inoculated 20 or 30% coal refuse slurries. Here 25 mg/l concentrations of SLS, ABS, and ABS plus BZ stimulated acid production. Formic, hexanoic, oxalic, propionic, and pyruvic acid at 0.1% concentrations were also effective inhibitors. Four different lignin sulfonates were only slightly effective inhibitors at 0.1% concentrations. It was concluded that acid formation resulting from microbial oxidation in high-sulfur coal refuse can be inhibited. (See also W87-06547) (Wood-PTT)
W87-06546

PREVENTION OF FORMATION OF ACID DRAINAGE FROM HIGH-SULFUR COAL REFUSE BY INHIBITION OF IRON- AND SULFUR-OXIDIZING MICROORGANISMS. II. INHIBITION IN 'RUN OF MINE' REFUSE UNDER SIMULATED FIELD CONDITIONS,
Ohio State Univ., Columbus. Dept. of Microbiology.
P. R. Dugan.
Biotechnology and Bioengineering BIBIAU, Vol. 29, No. 1, p 49-54, January 1987. 13 fig, 9 ref. DOI Grant 14-34-0001-8109.

Descriptors: *Acid mine drainage, *Mine drainage, *Coal mining, *Mine wastes, *Coal mining, *Inhibition, *Bacteria, *Acids, *Water pollution control, Microbial oxidation, Oxidation, Microorganisms, Pollutants, Iron, Sulfur, Sulfates, Slurries, Pyrite, Sodium lauryl sulfate, Benzoic acid, Lime.

The combination of sodium lauryl sulfate (SLS) and benzoic acid effectively inhibits iron- and sulfur-oxidizing bacteria in coal refuse and prevents the conversion of iron pyrite to sulfate, ferric iron, and sulfuric acid, thereby significantly reducing the formation of acidic drainage from coal refuse. The inhibitors were effective in a concentration of 1.1 mg/kg refuse, and data indicate that the SLS was in excess of the concentration required. The treatment was compatible with the use of lime for neutralization of acid present prior to inhibition of its formation. (See also W87-06546) (Author's abstract)
W87-06547

PHOSPHATE TRANSPORT DURING HYPOLIMNETIC AERATION,
National Water Research Inst., Burlington (Ontario).
D. R. S. Lean, D. J. McQueen, and V. A. Story.
Archiv fuer Hydrobiologie AHYBA4, Vol. 108, No. 2, p 269-280, December 1986. 6 fig, 23 ref.

Descriptors: *Phosphates, *Hypolimnetic aeration, *Limnology, *Isotope studies, *Water pollution treatment, *Phosphorus, *Hypolimnion, *Water quality, *Thermal stratification, *Sedimentation rates, *Lakes, Iron oxides, Precipitation, Aeration, Destratification, Sediment-water interfaces, Adsorption, Nutrients, Rehabilitation.

Hypolimnetic aeration is thought to improve the eutrophic state of lakes; however, in only about 50% of case studies was the treatment successful. Measurements of the influence of aeration on phosphorus kinetics were taken in large (550 cu m) enclosures located in Lake St. George, Ontario. With aeration the thermal stratification pattern was unaltered, nor was any hypolimnetic phosphate transported to the surface waters. There was however some movement from hypolimnion to metalimnion. Transport rates were measured by adding radioactive phosphate to the hypolimnion and monitoring the change in isotope distribution as a function of time. Movement to the sediments under anaerobic conditions was insignificant. With hypolimnetic aeration the rate constant from the hypolimnion to the sediment was measured (about 1%/day) and followed zero order kinetics. Adding 300 microg/l of FeCl3.6 H2O to the hypolimnion increased the transport rate to the sediment fivefold in the aerated enclosure but the rate for the anaerobic enclosure remained near the limit of detection. Available iron in the hypolimnion of lakes is necessary for the effective reduction of phosphorus by hypolimnetic aeration. Redox relationships not only govern internal loading of phosphate under anaerobic conditions but adsorption of phosphorus to hydrous iron (III) oxides under aerobic conditions. Available iron and oxygen concentrations should be included in empirical relationships used to predict lake phosphorus concentrations from P loading. (Author's abstract)
W87-06562

SUBSURFACE VENTING OF VAPORS EMANATING FROM HYDROCARBON PRODUCT ON GROUND WATER,
Radian Corp., Austin, TX.
For primary bibliographic entry see Field 5B.
W87-06570

DETECTING CHANGES IN GROUND WATER QUALITY AT REGULATED FACILITIES,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
J. C. Loftis, J. Harris, and R. H. Montgomery.
Ground Water Monitoring Review GWMRDU, Vol. 7, No. 1, p 72-76, Winter 1987. 2 tab, 14 ref. DOI Grant 14-08-0001-G-1060.

Descriptors: *Pollutant identification, *Water quality standards, *Statistical analysis, *Environmental protection, Standards, Regulations, Seasonal variation, Legislation, Seepage.

The Resource Conservation and Recovery Act (PL 94-580) and related Federal and state legislation have mandated routine monitoring of ground water quality at regulated facilities. The objective of this activity is detection of adverse changes in ground water quality caused by the facilities. Failure to detect pollution, and incorrect determinations of pollution, can be very expensive. In an attempt to standardize regulatory data analysis, EPA has specified a standard statistical procedure for monitoring of certain facilities regulated under RCRA (40 CFR-Part 264, Appendix IV). Monitoring programs must be designed and operated to provide statistically sound information. Users of ground water quality data must understand the nature and limitations of information from monitoring. The authors present a general approach to analysis of ground water quality data in light of the stated objective. The suggested approach accounts for 'natural' variation in background water quality through pairing of observations. (Inadequate methods of accounting for such variation - e.g., seasonality - are a difficulty in the EPA's recommended procedure for analysis.) Techniques that can be applied to the different data from paired wells include statistical tolerance limits and trend testing. The limitations of quarterly sampling for detecting small changes in quality over a short time frame are discussed. (Airone-PTT)
W87-06573

HYPOTHESIZED CARBON FLOW THROUGH THE DEEPWATER LAKE ONTARIO FOOD WEB,
State Univ. of New York Coll. at Oswego. Research Center.
For primary bibliographic entry see Field 2H.
W87-06587

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

STUDY OF MULTIRESERVOIR OPERATION WITH MINIMUM DESIRABLE FLOW CONSTRAINTS,
Kansas Water Resources Research Inst., Manhattan.
E. C. Pogge, Y. S. Yu and, and G. T. Wang.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87 131777/AS, Price codes: A04 in paper copy, A01 in microfiche. Contribution No. 251, September 1985. 49 p, 5 tab, 15 fig, 4 ref, append. Contract No. 14-08-0001-G907, Project No. USGS G907-06.

Descriptors: *Flow constraints, *Reservoir operation, *Instream flow, Linear decision rule, Chance-constrained problem, Optimization, Kansas, Multipurpose reservoirs, Upper Cottonwood-Neosho River basin, Linear programming, Drawdown.

This study concerns the operation of the three-reservoir system of the Upper Cottonwood-Neosho River basin under the constraints of minimum desirable in-stream flows as specified in the Kansas State Water Plan in addition to committed conservation storages for water supply. The water problem is formulated as a chance-constrained optimization problem using the linear decision rule. The resulting deterministic linear programming has been solved to obtain the decision parameters for monthly operation of the system. Two objective functions are used: one for minimization of the total drawdown of the system and the other for minimization of the maximum drawdown. The latter objective function apparently gives a better operating policy as evaluated by the performance of the system for simulated operations. The results show that with minimum desirable in-stream flow constraints, no feasible solution can be found with reliability larger than 70%. Without the minimum desirable flow constraints, the maximum reliability achievable is about 82%. (Pogge-KS U.)
W87-06093

INCORPORATING A RULE-BASED MODEL OF JUDGEMENT INTO A WASTEWATER TREATMENT PLANT DESIGN OPTIMIZATION MODEL,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W87-06097

MULTICRITERIA MANAGEMENT OF GROUNDWATER QUALITY UNDER UNCERTAINTY,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W87-06099

INTRODUCTION TO COMPUTING,
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
A. James.
IN: An Introduction to Water Quality Modelling, John Wiley and Sons, Chichester, England. 1984. p 17-25, 1 fig.

Descriptors: *Water quality management, *Computers, *Mathematical models, Computer programs, Computer models, Water management.

All but the simplest of mathematical models require the use of a computer, but it is important that the computational aspects of modeling are kept in perspective as computing can all too easily become a way of life. The aim of computing is to obtain as easily and efficiently as possible the output in a suitable form. There needs to be a balance between the time and effort in programming and the efficient use of the computer. Sophistication in programming is not necessarily a virtue. The first choice to be made in computing is the type of computer (hardware). This is determined by consideration of model size (amount of data storage) cost, etc. The rapid developments in computer technology make advice rapidly out of data but the general trend in hardware is toward smaller machines and much modelling work can be carried out on 16K or 32K machines. Large estuarial and marine models obviously require greater storage and processing power. Careful consideration of the computing requirements, and the length of time required for the computer to carry out the calculations, needs to be made based not only on modeling, but also on other computing needs. The other aspect of choice is in the software, i.e., the purchase of commercial programs. (See also W87-06216) (Lantz-PTT)
W87-06218

INTRODUCTION TO NUMERICAL METHODS,
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
D. J. Elliott.
IN: An Introduction to Water Quality Modelling, John Wiley and Sons, Chichester, England. 1984. p 26-49, 14 fig, 6 ref.

Descriptors: *Water quality management, *Mathematical techniques, *Model studies, Mathematical models, Water quality control, Mathematical equations, Linearity, Gauss elimination methods, Mathematical analysis.

The process of formulation of a water quality model may be broken down into a discrete number of steps, the first two of which are: (1) identify the physical, chemical and biochemical laws which govern the system under consideration; and (2) express these laws in a precise mathematical form. Frequently, in water quality models, the equations produced in step (2) are not amenable to direct analytical solution and simplifying assumptions are made to reduce the complexity of the problem. Often, the equations are reduced to a level at which an analytical solution is possible. However, even with a simplified formulation it may be more convenient to use a numerical rather than an analytical approach to finding a solution. This chapter introduces some of the numerical techniques which may, with the aid of a computer, form the basis of a water quality model. Some of these are: determinants, linearity and the existence of solutions, cofactors, Gauss elimination methods, and the iterative method. (See also W87-06216) (Lantz-PTT)
W87-06219

CRITICAL ASSESSMENT OF FORECASTING IN WATER QUALITY GOALS IN WESTERN WATER RESOURCES MANAGEMENT.
American Water Resources Association, Bethesda, MD.
For primary bibliographic entry see Field 7A.
W87-06238

LONG-RANGE STREAMFLOW FORECASTING: A STATE AGENCY PERSPECTIVE,
California State Dept. of Water Resources, Sacramento. Div. of Planning.
For primary bibliographic entry see Field 7A.
W87-06239

FLOOD FORECASTING FOR A POTENTIAL SPIRIT LAKE DEBRIS DAM BREAK,
National Weather Service, Portland, OR. Northwest River Forecast Center.
For primary bibliographic entry see Field 2H.
W87-06246

APPLICATION OF STREAMFLOW FORECASTS TO OPERATING A MULTI-RESERVOIR SYSTEM IN CENTRAL ARIZONA,
HyMet Co., Seattle, WA.
For primary bibliographic entry see Field 2E.
W87-06247

SEASONAL INFLOW FORECASTS BY A CONCEPTUAL HYDROLOGIC MODEL FOR MICA DAM, BRITISH COLUMBIA,
British Columbia Hydro and Power Authority, Vancouver. Operations Engineering Div.
For primary bibliographic entry see Field 2H.
W87-06248

ESTIMATING WATER SURFACE ELEVATION PROBABILITIES FOR THE GREAT SALT LAKE,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 2H.
W87-06249

SILVICULTURAL NONPOINT SOURCE WATER QUALITY MANAGEMENT UNDER SECTION 208 OF THE CLEAN WATER ACT,
National Council of the Paper Industry for Air and Stream Improvement, Inc., Corvallis, OR.
For primary bibliographic entry see Field 5G.
W87-06280

CALIFORNIA'S SILVICULTURAL 208 PROGRAM: A VIEW FROM THE TIMBER INDUSTRY,
Simpson Timber Co., Arcata, CA. California Operations.
For primary bibliographic entry see Field 5G.
W87-06281

ILLINOIS' PROCESS TO IDENTIFY, SCREEN AND PRIORITIZE RURAL WATER RESOURCE AND LAKE REHABILITATION PROJECTS,
Environmental Protection Agency, Chicago, IL. Region V.
For primary bibliographic entry see Field 5G.
W87-06282

WATER RESOURCES PLANNING,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
N. S. Grigg.
McGraw-Hill Book Company, New York, New York. 1985. 328 p, 73 fig, 51 tab, 173 ref.

Descriptors: *Water resources development, *Management planning, *Wastewater management, *Water quality control, Wastewater treatment, Storm water, Water supply, Economic aspects.

An attempt was made to answer the question of what can be done to solve the water crisis, and thus provide better water-related services at a reasonable cost without causing environmental damage. Covered are a wide variety of water problems: water supply, wastewater management, flood control, urban storm water management, national programs, and water quality management, among others. The problems are viewed from the perspectives of local, state, and federal government, as well as from the perspective of the private sector. (Lantz-PTT)
W87-06448

HYPOTHESIZED CARBON FLOW THROUGH THE DEEPWATER LAKE ONTARIO FOOD WEB,
State Univ. of New York Coll. at Oswego. Research Center.
For primary bibliographic entry see Field 2H.
W87-06587

6B. Evaluation Process

WATER RESOURCES IN TEXAS: THE NEED FOR A WATER RESEARCH AGENDA.
Texas Univ. at Austin. Center for Research in Water Resources.
Water Resources Symposium Number Eleven. University of Texas at Austin. Center for Research in Water Resources, 1984. Edited by Ernest T. Smerdon. 252 p.

Descriptors: *Water resources development, *Texas, *Research priorities, Management planning, Water management, Water policy.

This eleventh volume in the Water Resources Symposium series of the Center for Research in Water Resources is directed at the topic of establishing a water resources research agenda. The papers presented explore the problems and offer suggestions to strengthen future water resources research. It is believed that a strong research program in water resources is the one way that a society can insure against potential catastrophe. Research will not prevent future water problems from occurring, but it can provide many solutions. Through research ways can be found to assure that water problems do not dim the bright future for Texas and its citizens. (See also W87-06145 thru W87-06161) (Lantz-PTT)
W87-06144

WATER CHALLENGES FOR TEXAS,
Texas Secretary of State, Austin.
J. W. Fainter.
IN: Water Resources in Texas: The Need for a Water Research Agenda. Water Resources Symposium Number Eleven. University of Texas at Austin. Center for Research in Water Resources, 1984. p 3-7.

Descriptors: *Texas, *Water resources development, Water management, Funding, Research needs, Water resources protection, Water supply, Water demand.

Many problems must be addressed when developing plans for water resources management. Some of these are: (1) funding; (2) flood control and drainage; (3) protection of bays and estuaries; (4) water supply and demand in urban areas; (5) diminishing water supply in Texas, and its alternatives; (6) future technologies; and (7) control of resources by state, federal or local agencies. (See also W87-06144) (Lantz-PTT)
W87-06145

RESEARCH - A VITAL LINK IN EFFECTIVE WATER MANAGEMENT,
Florida Univ., Gainesville. Dept. of Engineering Sciences.
W. Viessman.
IN: Water Resources in Texas: The Need for a Water Research Agenda. Water Resources Symposium Number Eleven. University of Texas at Austin. Center for Research in Water Resources, 1984. p 23-34, 5 ref.

Descriptors: *Research priorities, *Water management, *Water resources development, Management planning, Water policy, Drinking water, Waste management, Water quality control, Irrigation, Water supply, Water demand.

Rapid rates of growth of population and technology, an almost instantaneous world-wide communication capability, and continuously shifting social and political objectives make it difficult for planners to project even a few years ahead. Long-lasting solutions to many of the toughest water problems facing this nation can be achieved only if they are supported by thorough and competent research. For example, the cooperative water management program developed for the Potomac River Basin would never have come about if it had not been for research that proved that the proposed operating policy could save construction costs and result in added availability of water during low-flow periods. Research is needed on many issues such as the health effects of various constituents in drinking water, the disposal of solid and hazardous wastes, more economic methods for wastewater renovation, groundwater quality in-stream flow requirements, weather modification, and irrigation needs. But research, if it is to be of value, must be responsive to the needs of society, and researchers must be ready to demonstrate how their technical achievements can be applied to practical advantage by those who must plan, design, construct, operate, and maintain the nation's water infrastructure. (See also W87-06144) (Lantz-PTT)
W87-06146

WATER DIPLOMACY,
Lyndon B. Johnson School of Public Affairs, Austin, TX.
E. Rostow.
IN: Water Resources in Texas: The Need for a Water Research Agenda. Water Resources Symposium Number Eleven. University of Texas at Austin. Center for Research in Water Resources, 1984. p 35-42.

Descriptors: *Water resources development, *Water management, Evaluation, Water policy, Economic aspects, Water supply, Water demand.

This paper addresses the often frustrating ignorance of diplomats when trying to explain the difficulties which can arise when water resources are discussed. To prevent such difficulties four problems must be dealt with. These are: (1) varying perceptions of the nature of the water problem; (2) length of time required to develop water policies; (3) economic aspects of water supply and demand; and (4) effecting change based on anticipation. (See also W87-06144) (Lantz-PTT)
W87-06147

SOME LEGAL ISSUES THAT MUST BE ADDRESSED,
Texas Univ. at Austin. School of Law.
For primary bibliographic entry see Field 6E.
W87-06148

FINANCING WATER RESOURCES PROJECTS IN TEXAS,
Vinson and Elkins, Houston, TX.
For primary bibliographic entry see Field 6C.
W87-06149

FINANCING WATER DEVELOPMENT,
Lyndon B. Johnson School of Public Affairs, Austin, TX.
For primary bibliographic entry see Field 6C.
W87-06150

RELATIONS OF WATER AND THE ECONOMIC HEALTH OF TEXAS,
Texas Research League, Austin.
J. E. Hazleton.
IN: Water Resources in Texas: The Need for a Water Research Agenda. Water Resources Symposium Number Eleven. University of Texas at Austin. Center for Research in Water Resources, 1984. p 83-112, 3 fig, 6 tab, 10 ref.

Descriptors: *Water resources development, *Management planning, *Texas, Water use, Water management, Water policy, Water supply, Water demand, Water rights, Financing.

The economics of water in Texas are examined, beginning with an analysis of the most recent projections of demand and supply of water in the state. This is followed by brief analyses of municipal and industrial water use and the use of water in agriculture, and by an examination of the economics of water conservation and use. Based on this analysis of the relationship between water and the economic health of Texas, and the economics of water conservation and use, a number of conclusions can be drawn about water planning policy for Texas. In addition, a few areas of research can be suggested. These are: (1) water planning should be based on the estimated available water within the state; (2) water planning should be viewed comprehensively; (3) water planning should be based on regional assessments of supply and demand; (4) the problem of irrigated agriculture on the Texas High Plains should be dealth with separately; (5) consideration should be given to developing regional approaches to major water problems; (6) careful consideration should be given to institutional and legal changes affecting water conservation and use; (7) groundwater regulation; (8) river authorities; (9) water rights; (10) the legal and institutional impedements to the conjunctive use of surface and groundwater should be identified and addressed; (11) water plans should reflect a clear understanding of the economics of water resources. (See also W87-06144) (Lantz-PTT)
W87-06151

WATER RESOURCES AND THE COASTAL ZONE,
North Carolina State Univ. at Raleigh. Sea Grant Coll. Program.
For primary bibliographic entry see Field 2L.
W87-06155

ROLE OF UNIVERSITIES IN SOLVING FUTURE WATER PROBLEMS,
Texas Univ. System, Austin. Board of Regents.
H. N. Richards.
IN: Water Resources in Texas: The Need for a Water Research Agenda. Water Resources Symposium Number Eleven. University of Texas at Austin. Center for Research in Water Resources, 1984. p 247-252.

Descriptors: *Water resources development, *Education, *Research priorities, *Texas, Funding, Financing, Public policy, Legal aspects, Economic aspects, Management planning.

Water resources have historically been viewed as a public sector problem. Past research in water resources has been largely supported with federal funding. However, little federal funding for water research is anticipated in the future. Therefore, as the Texas 2000 Commission suggests, the state will have to pick up the tab if it expects the research to be done. Regretfully, Texas's record in this regard is not good. This must change. The universities must have continuity of funding if they are to develop strong programs which utilize the abilities of the best faculty. The future water resources research programs of the universities must be broad based and include engineering, the physical sciences, the biological sciences, public policy, law, and economics - to name only a few of the disciplines which must be encompassed. Although the universities are not in the business of water planning, they should provide the results of sound research to aid those with water planning responsibility. It is equally important for them to provide a quality education to those who will be the future Texas water planners and who will develop the necessary future projects. (See also W87-06144) (Lantz-PTT)
W87-06161

EFFECTS OF RUNOFF FORECASTING ON COLORADO RIVER OPERATIONS AT HOOVER DAM,
Bureau of Reclamation, Boulder City, NV. Lower Colorado Region.
J. Burke, and D. Stevens.
IN: A Critical Assessment of Forecasting in Water Quality Goals in Western Water Resources Management, Proceedings of a Symposium held in Seattle, Washington, June 11-13, 1984. 1985. p 47-53, 3 fig, 1 tab, 2 ref.

Descriptors: *Runoff, *Forecasting, *Colorado River, *Hoover Dam, *Reservoir operation, Water resources development, Water management, Flood control.

During the past few years, the filling of the Colorado River Reservoirs has changed the nature of the prevailing river operation from delivery of minimum water requirements to flood control. The runoff volume forecasted has changed from an incidental to a crucial element among the factors involved in operation of the reservoir system. An understanding of the potential for forecasting error is a key to minimizing the risk factors involved in a flood control operation. The forecast of the runoff can have a dramatic impact on operational requirements, particularly at Hoover Dam and downstream. This paper discusses the Colorado River system's capacities and demands, its flood control requirements, the Colorado River Forecasting Service, and the mean and maximum runoff forecasts and reservoir system space affect operations

at and below Hoover Dam. (See also W87-06238) (Author's abstract)
W87-06244

SOME ISSUES IN ASSESSING THE ACCURACY OF HYDROLOGIC FORECASTS,
Washington Univ., Seattle. Dept. of Civil Engineering.
D. P. Lettenmaier.
IN: A Critical Assessment of Forecasting in Water Quality Goals in Western Water Resources Management, Proceedings of a Symposium held in Seattle, Washington, June 11-13, 1984. 1985. p 109-116, 5 fig, 4 tab, 17 ref.

Descriptors: *Hydrologic models, *Forecasting, *Performance evaluation, Economic aspects, Model studies, Statistical analysis, Mathematical models, Simulation analysis, Monte Carlo Method, Runoff forecasting.

Substantial economic benefits which might be attributed to improvements in the accuracy of long term hydrologic forecasts have been demonstrated, even for modest reductions in forecast errors. However, the detectability of differences in forecast accuracy which may result either from improved models or data collection have received little attention. Past model comparison studies have been flawed by improper model verification and in some cases, by the use of misleading statistics such as the correlation between the recorded and forecasted runoff. In this paper, a statistic for discrimination of the mean squared forecast error for competing forecasting models is proposed, and critical test statistics and power functions are derived using Monte Carlo Techniques. The results show that forecast error sequences of many years' length will be required to verify modest forecast accuracy improvements. For instance, to verify claimed improvements in Colorado runoff forecasts which have been attributed to satellite snow cover information would quite likely require in excess of 50 years of data. The use of simulated data is suggested as an alternate approach for forecast model comparisons. (See also W87-06238) (Author's abstract)
W87-06250

ECONOMIC VALUE OF WATER,
World Resources Inst., Washington, DC.
D. C. Gibbons.
A Study from Resources for the Future, Washington, DC. 1986. 101 p, 14 fig, 23 tab, 140 ref.

Descriptors: *Value, *Water costs, *Water demand, *Water resources development, *Water use, Consumptive use, Irrigation, Navigation, Hydroelectric power, Waste-assimilative capacity, Aesthetics, Recreation, Nonconsumptive use, Economic aspects, Water supply, Pricing.

This study of the value of water was undertaken as part of a larger project designed to improve understanding of the nature of the United State's water problems and alternative ways of dealing with them. It provides a theoretical framework for examining water values, discusses methodologies of estimation, and summarizes a substantial published and unpublished literature on the value of and demand for water in various sectors. Water valuation methods and demand are presented for municipal use, irrigation, industrial use, waste assimilation, recreational and aesthetic uses, navigation, and hydroelectric power production. Although no special significance should be attached to any of the individual water values reported because they are based on conditions existing at specific times and places, the discussions of the measurement of various values, and of the ranges of values generally associated with particular uses are of interest to water planners, engineers, economists and environmentalists. By focusing attention on relative water values and their measurement, the study offers strong evidence of the shortcomings of a tradition whitch assumes that offstream water uses are insensitive to price and warrant priority over all instream uses. (Geiger-PTT)
W87-06611

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

STUDY OF MANAGERIAL IRRIGATION COST ESTIMATION PROCEDURES,
Kansas Water Resources Research Inst., Manhattan.
J. R. Williams, H. L. Manges, O. H. Buller, G. J. Dvorak, and P. D. Etzold.
Available from the National Technical Information Service, Springfield, VA 22161 as PB87 131694/AS, Price codes: A04 in paper copy, A01 in microfiche. Contribution No. 247, September 1985. 48 p, 3 tab, 1 fig, 15 ref. Contract No. 14-08-0001-G907, Project No. USGS G907-02.

Descriptors: *Irrigation efficiency, *Irrigation costs, *Irrigation systems, Irrigation, Economics, Computer models, Water conservation, ICEASE model, Irrigation water use, Management.

Establishment of efficient farm irrigation practices is influenced by the knowledge the irrigator has concerning both the economic and technological aspects of irrigation. The eventual goal of water conservation research is to have water users establish conservation techniques as part of their continuing operating procedure. However, water conservation management techniques will be incorporated into on-going operations by managers when there is economic incentive to do so. The farm manager requires a basic understanding of the economics of water use in order to evaluate adjustments to the irrigation system or management of water. ICEASE (Irrigation Cost Estimator and System Evaluator) a micro-computer model is designed and developed to meet the need for conducting economic evaluation of adjustments to irrigation systems and management techniques to improve the use of irrigated water. ICEASE is designed to calculate the operating costs for operating irrigation systems. In addition to calculating the annual operating costs, the model has five options that can be used to economically evaluate improvements in the pumping plant or the way the irrigation system is used for crop production. (Williams-KSU,WRRI)
W87-06101

FINANCING WATER RESOURCES PROJECTS IN TEXAS,
Vinson and Elkins, Houston, TX.
D. L. Howell.
IN: Water Resources in Texas: The Need for a Water Research Agenda. Water Resources Symposium Number Eleven. University of Texas at Austin. Center for Research in Water Resources, 1984. p 53-62, 1 tab.

Descriptors: *Water resources development, *Financing, *Texas, Cost analysis, Federal jurisdiction, State jurisdiction, Public policy, Legislation, Economic aspects.

Strengthening and developing a water project is the best constructive method to deal with financing for water plans. The role of the state is twofold; state loans for funding and guidance for the public interest. Federal involvement is with long-term financing and legislative backup. This legislation and constitutional authority can provide better long-term financing interest rates than those currently available. (See also W87-06144) (Lantz-PTT)
W87-06149

FINANCING WATER DEVELOPMENT,
Lyndon B. Johnson School of Public Affairs, Austin, TX.
G. A. Rohlich.
IN: Water Resources in Texas: The Need for a Water Research Agenda. Water Resources Symposium Number Eleven. University of Texas at Austin. Center for Research in Water Resources, 1984. p 63-82, 4 tab, 9 ref.

Descriptors: *Water resources development, *Financing, *Water policy, State jurisdiction, Management planning, Economic aspects, Water conservation, Water costs, Loans, Bond issues.

The Lyndon B. Johnson School of Public Affairs is conducting a policy research project on financing water development in Texas. The project is sponsored by the Texas Department of Water Resources and the Texas Energy and Natural Resources Advisory Council. An initial objective of the project was to determine the types of programs used in other state for planning, development, management, and financing of water resources. To obtain the information, the states were surveyed by questionnaire. Fourteen respondents report that their states have conducted a comprehensive needs study, although Indiana's did not consider financial matters. Five other needs studies are under way. Thirteen of the responding states have a state water plan; four others are in progress. There is no relation between states having studies and those having plans. When asked what were the most critical water problems facing their states, water officials differed widely in their responses. Inadequate water supply was cited by officials in twenty-three states as a very pressing problem; in eighteen of those states short supply was designated as either the first or second most important problem. Pollution of groundwater and/or surface water was one of five major concerns for respondents in 28 states. Twenty-four of the responding states have adopted water conservation programs. The thirty-eight survey responses indicate that almost all of those states have taken an active role in some aspect of water finance or at least recognize the need for such a role in the near future. In order to meet their various water resource requirements, the states are providing financial assistance both through direct state financing and through aid to political subdivisions in support of local efforts. In addition to traditional means of financing such as bonds, loans, grants, and state appropriations, some states have developed more innovative approaches such as bond banks and regional water conservancy districts with authority to levy property taxes. (See also W87-06144) (Lantz-PTT)
W87-06150

RELATIONS OF WATER AND THE ECONOMIC HEALTH OF TEXAS,
Texas Research League, Austin.
For primary bibliographic entry see Field 6B.
W87-06151

METER TESTING PROGRAM LEADS TO FAIR AND EQUITABLE WATER BUSINESS,
Moore and Kling, Inc., Northborough, MA.
A. A. Betteridge.
Journal of the New England Water Works Association JNEWA6, Vol. 100, No. 4, p 394-411, December 1986. 4 ref.

Descriptors: *Planning, *Project planning, *Water metering, *Economic aspects, *Cost analysis, Cost allocation, Cost-benefit analysis, Water management, Long-term planning, Costs, Maintenance, Measuring instruments, Testing procedures, Field tests.

Methods of developing water meter testing plans were discussed. In order to have a successful meter testing program the whole meter system must be dealt with in a manageable fashion and the financial impact issues must be addressed. The steps in a planned water meter testing program should include: (1) development of a comprehensive overview and analysis of meter data i.e. consumption rates, meter ages, meter sizes; (2) organization of meters into testing phases with an associated timetable; and (3) surveying of all large meters in the system prior to testing to gather information on types of meters, necessary service interruptions during testing, and conditions of meters. It was recommended that the AWWA proposed Schedule for Meter Testing be used as a guideline for developing a plan for maintaining the accuracy of a water meter system through an ongoing scheduled testing program. (Wood-PTT)
W87-06548

METERING OF CONDOMINIUMS AND SUBDIVISIONS,
Portland Water District, ME.

D. E. Wyman.
Journal of the New England Water Works Association JNEWA6, Vol. 100, No. 4, p 412-417, December 1986.

Descriptors: *Water metering, *Condominiums, *Subdivisions, *Economic aspects, *Evaluation, *Planning, Portland, Maine, Water districts, Costs, Public utility districts.

The Portland Water District is a non-profit Quasi-Municipal Corporation which provides water to 40,000 accounts and serves a population of 160,000 people in three cities and seven towns in the Greater Portland area. The decision to individually or master meter new developments is not based on cost, but on how the District can best serve the development. Most area developers want to install a public system when possible since the District ends up funding one-third of the cost of a public system in a development in order to encourage the orderly growth of the system. The various options available to the developer include: (1) public water mains, hydrants, with individual services and meters; (2) public water mains, hydrants, and large services to serve clustered units with a single meter in an underground meter box at the edge of the right-of-way; or (3) a large combined fire and domestic service with a large meter in an underground meter box on a private property adjacent to the edge of the public right-of-way with all development piping remaining private. Ways of selecting the correct option are detailed and sample cost comparisons are presented for the various options. (Wood-PTT)
W87-06549

METERING OF CONDOMINIUMS AND SUBDIVISIONS IN HAVERHILL, MASSACHUSETTS,
H. D. Nickerson.
Journal of the New England Water Works Association JNEWA6, Vol. 100, No. 4, p 418-424, December 1986.

Descriptors: *Water metering, *Condominiums, *Subdivisions, *Economic aspects, *Evaluation, *Planning, Haverhill, Massachusetts, Water districts, Costs, Public utility districts, Legal aspects, Water demand, Domestic water, Water measurement, Standards, Specifications.

The City of Haverhill, Massachusetts is expanding rapidly with approximately 3000 units under construction which has put a considerable amount of strain on all aspects of the water department from a manpower standpoint as well as on the antiquated system. All newly constructed buildings are required to have developer/owner-supplied water meters which are approved by the Water Department and include an outside reading device. Details of meter testing, water billing, cost of water in the district, and meter installation specifications are presented. (Wood-PTT)
W87-06550

METERING OF CONDOMINIUMS AND SUBDIVISIONS,
Bridgeport Hydraulic Co., CT.
For primary bibliographic entry see Field 6E.
W87-06551

PRICE ELASTICITY OF WATER DEMAND WITH RESPECT TO THE DESIGN OF WATER RATES,
Coffin and Richardson, Inc., Boston, MA.
V. F. Pennacchio.
Journal of the New England Water Works Association JNEWA6, Vol. 100, No. 4, p 442-452, December 1986. 1 tab, 15 ref.

Descriptors: *Water rates, *Water costs, *Water demand, *Economic aspects, *Price elasticity, Prices, Costs, Data collections, Data analysis, Regression analysis, Model studies, Industrial water, Water use, Economic feasibility, Pricing, Economic efficiency.

Price elasticity theories and existing price elasticity studies of water demand were reviewed. It was concluded that: (1) the price elasticities of water demands are required in order to evaluate the reasonableness of the various demand modification pricing techniques properly; (2) existing works do not appear to provide conclusive evidence of the price elasticities of water demand because they are too general in both type of water demand and study area and because there was great variance in data collection and analysis methods; (3) standardization of data assembly, study procedures, and regression models is required in order to obtain consistent and reliable results; (4) price elasticities should be determined for various types of water demands; (5) price elasticities should have reference to some economic bench mark to locate the point at which the price elasticity coefficient may be applicable; (6) industrial price elasticity studies should take into consideration the type of product manufactured and water demand per unit among other variables; and (7) price elasticity studies are complex and require a great deal of data which will be likely to render them too expensive to perform. Unless price elasticities of water demand are defined and can be calculated reasonably, the success of marginal cost or other demand modification pricing techniques cannot be predicted. The wisdom of replacing rates based on actual costs with those based on marginal costs was concluded to be dubious when price elasticities are unknown. (Wood-PTT)
W87-06552

FINANCING AND CHARGES FOR WASTEWATER SYSTEMS: A SPECIAL PUBLICATION,
Water Pollution Control Federation, Washington, DC.
For primary bibliographic entry see Field 5D.
W87-06617

SEWER CHARGES FOR WASTEWATER COLLECTION AND TREATMENT - A SURVEY,
Water Pollution Control Federation, Washington, DC.
For primary bibliographic entry see Field 5D.
W87-06620

6D. Water Demand

COORDINATED USE OF GROUNDWATER AND SURFACE WATER IN TEXAS,
Texas Dept. of Water Resources, Austin. Planning and Development Div.
H. W. Grubb, and J. D. Beffort.
IN: Water Resources in Texas: The Need for a Water Research Agenda. Water Resources Symposium Number Eleven. University of Texas at Austin. Center for Research in Water Resources, 1984. p 123-136, 1 tab.

Descriptors: *Water use, *Conjunctive use, *Texas, *Groundwater, *Municipal water, *Water supply, Surface water, Economic aspects, Wells, Pumps, Water transport, Legal aspects, Water rights.

Most of the 93 cities and water supply entities that now use water from both ground and surface sources began by using a single source of supply, groundwater. As water demands grew and groundwater supplies became inadequate to meet the growing needs, surface water supplies were developed. These cities have maintained dual supplies for several reasons: the amount of useful capital invested in both sources; the inherent advantages of each source; and, the knowledge that neither source, by itself, can satisfy all of the demands all of the time. The capital invested by municipal water utilities in wells, pumps, collection and delivery pipelines, and surface water intake structures is substantial. Groundwater and surface water possess certain advantages and disadvantages unique to the source. Groundwater, for example, is not subject to evaporation, maintains relatively constant temperature and chemical quality, and because of its slow movement can be left in 'storage' for later use. However, most aquifers cannot meet potential demands that might be placed on them by heavy local or regional pumping which exceeds recharge. Further, contamination and pollution would be difficult and time consuming to correct if it occurred. Surface water, on the other hand, is somewhat more readily controlled, measured, and managed. Although surface water is somewhat more susceptible to contamination and pollution than groundwater, it can be cleansed much more easily should contamination occur. However, lakes and rivers are subject to losses by evaporation and infiltration. Texas laws relating to groundwater are quite different from those relating to surface water. The difference in the status of groundwater and surface water rights impinges on the management of water supply systems. A municipal water utility using dual supplies should own or control the land surrounding well fields in order to control and manage the water resources of those aquifers well, including any water that is recharged to them. This procedure then becomes a management program that can increase the water resources available to a water district or city. (See also W87-06144) (Lantz-PTT)
W87-06153

IRRIGATION EFFICIENCIES,
International Inst. for Land Reclamation and Improvement, Wageningen (Netherlands).
For primary bibliographic entry see Field 3F.
W87-06234

IRRIGATION REQUIREMENTS FOR DOUBLE CROPPING OF LOWLAND RICE IN MALAYA,
International Inst. for Land Reclamation and Improvement, Wageningen (Netherlands).
For primary bibliographic entry see Field 3F.
W87-06235

DEMAND FORECASTING: ORACLE OR TOOL,
Washington Univ., Seattle. Dept. of Geography.
M. E. Marts.
IN: A Critical Assessment of Forecasting in Water Quality Goals in Western Water Resources Management, Proceedings of a Symposium held in Seattle, Washington, June 11-13, 1984. 1985. p 135-137, 4 ref.

Descriptors: *Hydroelectric power, *Water demand, *Forecasting, *Columbia River, Long-term planning, Economic aspects, Management planning, Water resources development.

Contrasted is the success of the program of constructing Federal multipurpose dams in the Columbia River Basin (the Federal Columbia River Power System), which proved to be a robust program despite some substantial errors in forecasting future power demand, with the debacle in the more recent program of adding large thermal power plants to the regional power system, and suggests that the region's electrical utility planners fell victim to the 'oracle syndrome.' Relying on annual load growth forecasts, the region's utilities announced the Hydro-Thermal Power Program in 1968, calling for an ambitious program of adding some 20 large thermal power plants over the following two decades, with concurrent enlargement of the Columbia River hydropower plants to carry the peaking load. This program failed the test of robustness. By the time weaknesses in the forecasts, primarily a result of the effect of price on consumption of electricity, were recognized, a multi-billion dollar development program was underway and in disarray. Subsequently, a majority of the thermal plants, which were invarious stages of construction or pre-construction, have been terminated, cancelled, or mothballed. Effective reexamination of the forecasts and recognition of the relationship between project costs, rates and consumption came too late to avoid a financial disaster of the first magnitude. The Columbia River hydropower system, on the other hand, provided power at such attractive rates that forecasting errors were irrelevant. (See also W87-06238) (Author's abstract)
W87-06253

WATER MARKETS FOR STREAM FLOW AUGMENTATION,
Washington State Univ., Pullman. Dept. of Agricultural Economics.
N. K. Whittlesey, and J. E. Houston.
IN: A Critical Assessment of Forecasting in Water Quality Goals in Western Water Resources Management, Proceedings of a Symposium held in Seattle, Washington, June 11-13, 1984. 1985. p 139-146, 7 tab, 12 ref.

Descriptors: *Water demand, *Streamflow, *Water use, Irrigation, Hydroelectric power, Agriculture, Water transfer, Water resources development.

Examined is the economic potential of creating water markets for exchanging water between irrigation and hydropower in the Pacific Northwest. A two-state decomposition type mathematical programming model representing PNW irrigated agriculture and the Columbia River hydropower system was used to analyze some of the market questions. Two scenarios are reported in this paper. The first considers a permanent transfer of water from irrigation to hydropower resulting in a constant decrease in agricultural production and similar increase in energy output. The second scenario proposed that the market require the transfer of water to energy production only in low streamflow periods say one in 10 years. The research results indicate a significant potential for water and energy conservation in irrigated agriculture. Under the assumption of transferable water rights, the regional social welfare could be increased by allowing the sale of water from agriculture to the nonagricultural sector for streamflow augmentation in critical flow periods. Agricultural income could be raised while the region could avoid some of the problems and capital costs of supplying energy through thermal power plants. The increased stream flows from reduced irrigation diversions would also be beneficial to other instream uses of water such as anadromous fisheries, navigation and recreation. Opportunities and impacts of this water market policy fall unevenly on regional irrigators, with upper river areas being affected the greatest amount. (See also W87-06238) (Author's abstract)
W87-06254

MODELING FOR LOCAL WATER MANAGEMENT,
Portland State Univ., OR. Dept. of Civil Engineering.
R. W. Koch, and R. L. Allen.
IN: A Critical Assessment of Forecasting in Water Quality Goals in Western Water Resources Management, Proceedings of a Symposium held in Seattle, Washington, June 11-13, 1984. 1985. p 149-156, 5 fig, 6 tab, 13 ref.

Descriptors: *Water management, *Model studies, *Water use, *Water demand, Water use, Water resources development, Streamflow, Soil water, Rivers, Hydrologic models, Computer models, Algorithms.

The task of managing water resources under the appropriative system of water rights normally becomes one of simply assuring that the legal priority is satisfied. To maximize the availability of water in such a tightly constrained system requires the cooperation of water users by increasing efficiency. To accomplish this, information on the best timing and amount of water application is required. As an aid to the local individual such as a watermaster in both making decisions and providing information to water users on water availability given the complex nature of the hydrologic system, software has been developed to allow the necessary analyses. Water rights information such as priority date, location, amount and type of use is computerized in combination with descriptions of the water use component, principally irrigation, and the river system. The water use component accounts for soil moisture while the river model accounts for the time varying response of streamflow to water withdrawals and inflows. The application of efficient computer algorithms allows use of the microcomputer. Applying these models, the water manager can investigate the effects of decisions regarding water distribution as well as provide short term forecasts of demand and availability to aid the water users in increasing their efficiency, thus providing greater supply. (See also W87-06238) (Author's abstract)
W87-06255

RESIDENTIAL WATER DEMAND FORECASTING AND CONSERVATION PROGRAM ASSESSMENT: TWO ECONOMIC MODELS,
Pacific Gas and Electric Co., San Francisco, CA. Dept. of Economics and Forecasting.
K. C. Lewis.
IN: A Critical Assessment of Forecasting in Water Quality Goals in Western Water Resources Management, Proceedings of a Symposium held in Seattle, Washington, June 11-13, 1984. 1985. p 157-160, 5 ref.

Descriptors: *Domestic water, *Water demand, *Forecasting, *Economic aspects, *Model studies, Water conservation, Water resources development, Water management.

Supplying additional water to meet increasing municipal demands is placing substantial financial burdens on American water utilities. To counter this trend many utilities have adopted a demand management approach which emphasizes the reductin of those demands through conservation programs. The effects of these programs, however, are difficult to quantify and evaluate and, as a consequence, forecasting and planning are very uncertain processes. The ambiguity of conservation analysis rests on an inadequate knowledge of consumer behavior. Two economic models which structure consumer choices and valuations are discussed in the context of residential water demands. The two models are the technical options model and the nonmarket valuation model. Both models are designed, in different ways, to measure consumer responses to rate structure changes and other relevant variables by specific end-uses. The technical options model accomplishes this by assessing demands derived by the household technology level. The nonmarket valuation model assesses demands through the elicitation of valuations which may be based on, among other things, beliefs in water shortages and environmental attitudes. Because either of these models would provide an enhanced conservation programs and forecasting demands affected by those programs. However, both models require extensive primary data and sophisticated model specification. Thus, the time and expense of applying such models must be carefully weighed with their forecasting and program assessment capabilities. (See also W87-06238) (Author's abstract)
W87-06256

SHORT-TERM FORECASTING OF MUNICIPAL WATER USE (WITH APPLICATION TO DROUGHT CONDITIONS),
Interstate Commission on the Potomac River Basin, Rockville, MD.
R. C. Steiner.
IN: A Critical Assessment of Forecasting in Water Quality Goals in Western Water Resources Management, Proceedings of a Symposium held in Seattle, Washington, June 11-13, 1984. 1985. p 161-165, 4 tab, 3 ref.

Descriptors: *Short-term planning, *Municipal water, *Water use, Forecasting, Water demand, Water resources development, District of Columbia, Drought.

The requirement for short-term water use forecasting is set in the context of water resources planning and management. Selection of appropriate variables for the model and analysis of the data are explained and justified. The three major water supply utilities in the Washington, D.C., metropolitan area provide an example for model development. Although the geographic setting for the model development is not 'Western,' the approach, methodology and procedure employed have universal applicability. A multivariate linear regression model is based on climatic and (lagged) water use variables. As an alternative formulation, a mixed model is developed by linear regression on climatic variables and the representation of residuals by an autoregressive moving averge (ARMA) process. An application is presented whereby the linear regression model is used to provide water use forecasts in the annual simulation of drought operating conditions. The forecasts are used to determine upstream reservoir releases with the use of five-day weather forecasts. Other potential applications inlcude revenue forecasting and examining the effects of rate changes and demand modification techniques. (See also W87-06238) (Author's abstract)
W87-06257

FARM WATER REQUIREMENT,
National Univ. of Singapore. Dept. of Civil Engineering.
For primary bibliographic entry see Field 3F.
W87-06481

PRICE ELASTICITY OF WATER DEMAND WITH RESPECT TO THE DESIGN OF WATER RATES,
Coffin and Richardson, Inc., Boston, MA.
For primary bibliographic entry see Field 6C.
W87-06552

ECONOMIC VALUE OF WATER,
World Resources Inst., Washington, DC.
For primary bibliographic entry see Field 6B.
W87-06611

6E. Water Law and Institutions

NONPOINT-SOURCE POLLUTION CONTROL: THE USDA POSITION,
Department of Agriculture, Washington, DC.
For primary bibliographic entry see Field 5G.
W87-05961

FEDERAL WATER DEVELOPMENT: GOING GOING,
L. Mosher.
Journal of Soil and Water Conservation JSWCA3, Vol. 41, No. 3, 164-166, May-June 1986.

Descriptors: *Water development, *Water resources planning, Bureau of Reclamation, Economics, Cost sharing, Irrigation systems, Flood control systems, Legislation, Government agencies, Construction, Army Corps of Engineers.

Over the past 10 years, the construction budget of the Army Corps of Engineers has shrunk 24% in appropriated dollars. Construction by the Bureau of Reclamation has declined 28%. At the two agencies there are 15% fewer people working for the Corps and 10 percent fewer for the bureau. Part of the reason for these reductions stems from a drive to shrink the federal government. Reduction in construction monies, is the result of a 10-year legislative moratorium on new water project authorizations. The congressional water moratorium could end this year. Both chambers have passed omnibus water bills with cost-sharing provisions. The Corps of Engineers says it has 22 of the 37 Corps projects needing cost-sharing agreements and another 9 possibles. The Bureau of Reclamation has been running out of new irrigation systems to build in the 17 western states it serves. Much of its work is devoted to finishing projects authorized years ago. According to a former assistant interior secretary, 'the bureau will be busy for the next 10 years with projects presently authorized and under construction. And it always will have a major operations and maintenance program, which is now running between $300 and $400 million. There will always be a role for the Bureau of Reclamation.' (Main-PTT)
W87-05964

METROPOLITAN FLOOD LOSS REDUCTION THROUGH REGIONAL SPECIAL DISTRICTS,
Massachusetts Univ., Amherst. Dept. of Geology and Geography.
R. H. Platt.
Journal of the American Planning Association

JAPAD9, Vol. 52, No. 4. p 467-479, Autumn 1986. 3 fig, 3 tab, 30 ref.

Descriptors: *Flood control, *Flooding, *Floods, *Flood damage, *Flood plain management, *Planning, *Nonstructural alternatives, *Urban planning, *Regional analysis, *Regional planning, *Regional districts, *Flood protection, *Floodproofing, Flood plain zoning, Flood plains, Damage, Protection, Urbanization, Local governments, Houston, Chicago, Denver.

Flood damage is increasing in U.S. metropolitan areas because of urbanization in small watersheds and flood plains and because of inadequate storm drainage. The National Flood Insurance Program is necessary but insufficient response to the problem. Additional measures and programs tailored to the particular region are needed since each area has different flood problems and operates in a different legal and political framework. Three regional districts were examined and their attempts at solving the problems associated with flooding were described. All three districts reflect a viewpoint that may be emulated elsewhere: that metropolitan floods are an areawide phenomenon requiring a regional response. Local flood plain management and state and federal mitigation efforts are necessary, but regional districts fill a functional and administrative gap in the hierarchy of public authority. Regional districts interact with other governmental organizations as well as act independently, as exemplified by the described detention policies of the Harris (located near Houston) and Chicago districts. A regional district also may perform a particular function more competently than another unit of government as shown by the given example of the Denver district's floodplain maps. The fiscal autonomy of the regional district allows it to take needed actions promptly and at no cost to the federal or state taxpayer. It was concluded that regional districts are effective in reducing flood losses. (Wood-PTT)
W87-06071

STRUCTURAL FLOOD MITIGATION WORKS AND ESTUARINE MANAGEMENT IN NEW SOUTH WALES - CASE STUDY OF THE MACLEAY RIVER,
New South Wales Dept. of Agriculture, Sydney (Australia). Div. of Fisheries.
For primary bibliographic entry see Field 6G.
W87-06074

USE OF SEVIN ON ESTUARINE OYSTER BEDS IN TILLAMOOK BAY, OREGON,
For primary bibliographic entry see Field 5G.
W87-06075

CONSERVATION ECONOMICS OF HAWAII'S SYSTEM OF WATER RIGHTS,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
H. Yamauchi.
IN: Collected Reprints, Volume V: 1978-1981, June 1984. Water Resources Research Center, Honolulu, Hawaii. p 87-92, 6 ref.

Descriptors: *Water law, *Water rights, *Hawaii, *Riparian rights, *Legal aspects, Water use, Water use efficiency, Groundwater management, Economic aspects, Water management, Water policy.

The system of Hawaiian water rights which evolved from ancient customs did not fit within the riparian appropriation scheme of other U.S. mainland states. Institutional innovations are the key to improving water resources conservation and management in Hawaii. Ambiguities in water rights are being tested in the courts. Ownership, usership and transfer are basic tenure concepts which need clarification for furthering the reasonable beneficial use principle. In 1959, a voluntary Ewa Groundwater Users Association was formed to emphasize the island-wide interest in groundwater management. Local water users associations can be legally authorized through legislation to represent the common property interests in water. This can have far-reaching implications for coordinating state water policy through local water users associations. (See W87-06103) (Geiger-PTT)
W87-06109

WATER DIPLOMACY,
Lyndon B. Johnson School of Public Affairs, Austin, TX.
For primary bibliographic entry see Field 6B.
W87-06147

SOME LEGAL ISSUES THAT MUST BE ADDRESSED,
Texas Univ. at Austin. School of Law.
C. W. Johnson.
IN: Water Resources in Texas: The Need for a Water Research Agenda. Water Resources Symposium Number Eleven. University of Texas at Austin. Center for Research in Water Resources, 1984. p 45-51.

Descriptors: *Water law, *Legal aspects, *Water resources development, Management planning, Water transport, Water use, Water allocation, Legislation, Water rights.

The present Texas law of water rights is a patchworked accretion of laws created to serve the needs of earlier times. This 'law' needs a comprehensive, thorough, critical examination, so that current issues can be addressed, such as: (1) unused water rights; (2) wasteful practices of transporters, storers, and users of water; (3) revision of statutes that govern allocation of remaining unappropriated water; and (4) transferability of water rights. (See also W87-06144) (Lantz-PTT)
W87-06148

RELATIONS OF WATER AND THE ECONOMIC HEALTH OF TEXAS,
Texas Research League, Austin.
For primary bibliographic entry see Field 6B.
W87-06151

COASTAL ZONE PROBLEMS - A FEDERAL PERSPECTIVE,
Corps of Engineers, Dallas, TX. Southwestern Div.
H. G. Robinson.
IN: Water Resources in Texas: The Need for a Water Research Agenda. Water Resources Symposium Number Eleven. University of Texas at Austin. Center for Research in Water Resources, 1984. p 113-121.

Descriptors: *Coastal zone management, *Federal jurisdiction, *Ecological effects, *Texas, Water resources development, Corps of Engineers, Permits, Legal aspects, Economic aspects.

The coastal zone is a dynamic area, particularly along the Texas coast. The vast and highly productive natural resources of the Texas Gulf Coast have been, and will continue to be, a major contributor to the prosperity and well-being of the state and the nation. The increasing demand for coastal resources makes it imperative that the impacts of these demands be monitored and that programs be put into effect that will help maintain these vital resources. A continued balance of future economic, environmental, and social needs along the coast requires a commitment from the populace, interested groups, private businesses, local governmental agencies, and federal agencies. The evolution of the Corps' regulatory program over the past decade or so has paralleled the environmental movement and the growth of the government's overall regulatory role during that period. The Section 404 program has gone far beyond its originally envisioned scope and, more importantly, beyond the appropriate role of the federal government in regulating the development of private and public resources involving this nation's waters and wetlands. The Corps now processes about 18,000 permits annually. Research development programs of the Corps of Engineers, the Corpus Christi Coastal zone, the Channel Side Disposal Plan, shrimp mariculture feasibility, and statutory requirements are discussed. This discussion makes evident that federal law assures that coastal resources will be protected and developed in an environmentally and economically feasible manner. There are many interests involved. The nation depends on port development as well as the protection of estuaries. From the federal perspective, both are needed. This will continue to require the patience of all interests. The Corpus Christi project is an example to the nation that the necessary compromises can be reached. (See also W87-06144) (Lantz-PTT)
W87-06152

ROLE OF UNIVERSITIES IN SOLVING FUTURE WATER PROBLEMS,
Texas Univ. System, Austin. Board of Regents.
For primary bibliographic entry see Field 6B.
W87-06161

NEW CHALLENGES TO ECOTOXICOLOGY,
Commission of the European Communities, Brussels (Belgium).
For primary bibliographic entry see Field 5G.
W87-06196

INDUSTRY AND THE ENVIRONMENTAL CHALLENGE,
For primary bibliographic entry see Field 5G.
W87-06197

U.S. FEDERAL LEGISLATION PERTAINING TO GROUNDWATER PROTECTION,
National Water Well Association, Worthington, OH.
For primary bibliographic entry see Field 5G.
W87-06215

INTERNATIONAL ASPECTS OF ACID DEPOSITION,
North Carolina State Univ. at Raleigh. School of Forest Resources.
For primary bibliographic entry see Field 5G.
W87-06259

U.S. NATIONAL ACID PRECIPITATION ASSESSMENT PROGRAM,
National Acid Precipitation Assessment Program, Washington, DC.
For primary bibliographic entry see Field 5C.
W87-06260

GREAT LAKES WATER QUALITY,
Ontario Ministry of the Environment, Toronto.
For primary bibliographic entry see Field 5G.
W87-06272

OHIO'S SOIL AND WATER CONSERVATION DISTRICTS (SWCDS): CAN THEY FULFILL NONPOINT SOURCE POLLUTION CONTROL RESPONSIBILITIES,
Ohio State Environmental Protection Agency, Columbus. Office of the Planning Coordinator.
For primary bibliographic entry see Field 5G.
W87-06277

STATE/FEDERAL RELATIONSHIPS IN WATER QUALITY MANAGEMENT ON THE NATIONAL FORESTS IN CALIFORNIA,
Forest Service, South Lake Tahoe, CA. Lake Tahoe Basin Management Unit.
For primary bibliographic entry see Field 5G.
W87-06278

POINT AND NONPOINT SOURCE ABATEMENT NEEDS FOR IMPROVING INTERSTATE WATER QUALITY,
Tennessee Valley Authority, Knoxville.
For primary bibliographic entry see Field 5G.
W87-06279

SILVICULTURAL NONPOINT SOURCE WATER QUALITY MANAGEMENT UNDER SECTION 208 OF THE CLEAN WATER ACT,
National Council of the Paper Industry for Air and

Stream Improvement, Inc., Corvallis, OR.
For primary bibliographic entry see Field 5G.
W87-06280

CALIFORNIA'S SILVICULTURAL 208 PROGRAM: A VIEW FROM THE TIMBER INDUSTRY,
Simpson Timber Co., Arcata, CA. California Operations.
For primary bibliographic entry see Field 5G.
W87-06281

WATER QUALITY AND THE NEW FARM POLICY INITIATIVES,
Economic Research Service, Washington, DC.
For primary bibliographic entry see Field 4C.
W87-06399

ECONOMIC IMPACT OF PROPOSED REGULATION R81-19 FOR SITE-SPECIFIC WATER POLLUTION RULES APPLICABLE TO CITIZENS UTILITIES COMPANY DISCHARGE TO LILY CACHE CREEK.
Ducharme (Robert G.), Inc., Deerfield, IL.
For primary bibliographic entry see Field 5G.
W87-06454

METERING OF CONDOMINIUMS AND SUBDIVISIONS,
Bridgeport Hydraulic Co., CT.
H. J. Ryder.
Journal of the New England Water Works Association JNEWA6, Vol. 100, No. 4, p 425-441, December 1986.

Descriptors: *Water metering, *Condominiums, *Legal aspects, *Cost allocation, Economic aspects, Bridgeport, Connecticut, Specifications, Standards, Domestic water, Housing, Documentation, Publications, Water mains.

The Bridgeport Hydraulic Company serves a population of approximately 446,000 people in 18 communities in three counties. Legal documents are included which define a premise and state that separate premises shall be separately metered and billed. Specifications and regulations for developers are also detailed in the legal documents. Special rules for condominium developers are presented with emphasis on the location and description of water mains. (Wood-PTT)
W87-06551

6F. Nonstructural Alternatives

WETLAND RESTORATION: A PILOT PROJECT,
Fish and Wildlife Service, Fergus Falls, MN.
For primary bibliographic entry see Field 2H.
W87-05962

INVOLVING HOMEOWNERS IN FLOOD MITIGATION,
New Orleans Univ., LA.
S. B. Laska.
Journal of the American Planning Association JAPAD9, Vol. 52, No. 4, p 452-466, Autumn 1986. 1 fig, 8 tab, 50 ref. DOC Grant NA81AA-D-00103.

Descriptors: *Public participation, *Floods, *Flood control, *Flood plain management, *Flood protection, *Floodproofing, *Flood damage, *Water control, *Nonstructural alternatives, Hazards, Damage, Protection, Louisiana, Education, Financial feasibility, Financing, Economic aspects, Insurance, Regulations.

Early efforts to mitigate flood hazards emphasized structural alternatives such as dams and levees. More recent strategies have stressed regulatory, nonstructural measures. In neither case has homeowner involvement been given a very important role. Frustrated with the limited success of past efforts, floodplain managers recently have become more interested in encouraging homeowners to take action on their own property to minimize flood damage. Earlier research indicated that the prospects for getting homeowners involved were discouraging. This conclusion was challenged by a study of the knowledge and actions of residents of Slidell, Louisiana. New evidence was presented which shows that homeowners who have been flooded recently are interested in mitigation and are willing to participate. The usefulness of several proposals for reducing flood damages through homeowner involvement and ways to promote homeowner involvement were examined. The proposals included: improving education about flood mitigation measures, altering the timing of mitigation measures, providing financial aid for floodproofing by homeowners, altering flood insurance regulations and working with neighborhood associations in their mitigation efforts. Recommendations on each of these proposals were detailed. (Wood-PTT)
W87-06070

METROPOLITAN FLOOD LOSS REDUCTION THROUGH REGIONAL SPECIAL DISTRICTS,
Massachusetts Univ., Amherst. Dept. of Geology and Geography.
For primary bibliographic entry see Field 6E.
W87-06071

6G. Ecologic Impact Of Water Development

ASSESSMENT OF ENVIRONMENTAL IMPACTS OF SARDA SAHAYAK CANAL IRRIGATION PROJECT OF UTTAR PRADESH, GOVERNMENT, INDIA,
A. Afroz, and P. P. Singh.
International Journal of Environmental Studies IJEVAW, Vol. 28, No. 2/3, p 123-130, 1986. 2 fig, 2 tab, 10 ref.

Descriptors: *Irrigation effects, *Environmental effects, *Irrigation canals, *India, *Canal seepage, *Water management, Canals, Seepage, Forests, Waterlogging, Water table rise, Public health, Parasites, Diseases, Human diseases, Land use, Forest management, Salinity, Alkalinity, Chemical properties, Legal aspects, Planning.

The operation of the Sarda Sahayak Canal Irrigation Project of the Uttar Pradesh Government (India) has created serious environmental degradation, including seepage damage to 385 villages and the displacement of 28,000 people from the canal site. Mature natural forests have been killed, and public health problems have arisen due to continuous waterlogging. Guidelines are presented for improving the efficiency of irrigation projects and assessing the impact on the environment. It is concluded that: (1) the development and management of irrigation systems should be based on prior interdisciplinary planning; (2) the catchment area should not be deforested; (3) detailed studies of local meteorology, soil, and water should be undertaken prior to canal construction; (4) there should be joint use of ground and surface water; (5) moisture-absorbing trees should be planted on the banks; (6) water storage capacity should be increased to conserve monsoon runoff; and (7) drainage should be developed parallel to the canal to check seepage. Specifications are provided for promoting overall irrigation efficiency. (Author's abstract)
W87-05995

STRUCTURAL FLOOD MITIGATION WORKS AND ESTUARINE MANAGEMENT IN NEW SOUTH WALES - CASE STUDY OF THE MACLEAY RIVER,
New South Wales Dept. of Agriculture, Sydney (Australia). Div. of Fisheries.
M. J. Middleton, M. A. Rimmer, and R. J. Williams.
Coastal Zone Management Journal CZMJBF, Vol. 13, No. 1, p 1-23, 1985. 5 fig, 1 tab, 35 ref.

Descriptors: *Water law, *Macleay River, *Estuarine environment, *Estuaries, *Flood control, *Environmental effects, *Legislation, *Legal aspects, *Environmental policy, Flood protection, Coasts, Environment, Floods, Flood proofing, Environmental control, Ecological effects, New South Wales.

In many estuaries of New South Wales agricultural, urban, and industrial activities have benefited at the expense of naturally occurring attributes such as commercial and amateur fisheries, wildlife habitats, recreational resources, and esthetic and cultural values. The successful future management of the estuarine environment is contingent on a number of factors, including a paucity of baseline data, a lack of predictive models, the difficulty of quantifying natural attributes, and a previous tendency to study the effects of each development proposal on an individual rather than cumulative basis. A positive step in estuarine management was recently taken by the government with the passage of legislation whereby environmental considerations are incorporated into planning and management procedures. However, shortcomings still exist in the overall management approach. Some of the shortcomings were illustrated in the examination of the adverse environmental effects of structural flood mitigation works in the Macleay River Estuary. Desirable considerations for the future management of estuaries are discussed. Particular emphasis is placed on the need for environmental compensation and habitat restoration, two concepts which, until recently, have had restricted application in coastal management in New South Wales. (Author's abstract)
W87-06074

DEVELOPMENT OF EMERGENT VEGETATION IN A TROPICAL MARSH (KAWAINUI, O'AHU),
Hawaii Univ. at Manoa, Honolulu. Dept. of Botany.
L. L. Smith.
Part 1 IN: Collected Reprints, Volume V: 1978-1981, June 1984. Water Resources Research Center, Honolulu, Hawaii. p 59-68, 4 fig, 53 ref.

Descriptors: *Marsh management, *Marsh plants, *Succession, *Environmental effects, *Land use, Marshes, Canals, Vegetation effects, Bogs, Tidal marshes, Ecological effects, Tropical regions, Vegetation establishment.

The effect of management of Kawainui Marsh on the present distribution and occurrence of plant species was studied. One of the processes associated with marsh development is terrestrialization of lakes into bogs and ultimately marsh meadows or forests. The taxa found in the floating mats of the marsh include primrose willow, sow thistle, giant bulrush, grasses, sawgrass, water hyacinth and duckweeds. The conspicuous plants found in the marsh today include para grass, swamp cyclosorus, water hyacinth, great bulrush, cattail, sawgrass, and paperbark trees. The marsh soils consist of Pearl Harbor clay and Hanalei silty clay. Marsh sediments originate from the Ka'ena Wailua association. The marsh is fed by the Maunawili Valley and Kahanaiki streams. The marsh has been used as a fishpond, taro and rice farm, sugarcane field, pastureland for cattle, and recreational activities. Many indigenous and introduced birds inhabit the marsh. Listings of indigenous fish and macroinvertebrates are also given. The Kawainui Canal was dug in 1952 and a 3-m high levee was constructed in 1966. (See also W87-06103) (Geiger-PTT)
W87-06107

DEVELOPMENT OF EMERGENT VEGETATION IN A TROPICAL MARSH (KAWAINUI, O'AHU),
Hawaii Univ. at Manoa, Honolulu. Dept. of Botany.
L. L. Smith.
Part 2. IN: Collected Reprints, Volume V: 1978-1981, June 1984. Water Resources Research Center, Honolulu, Hawaii. p 102-114, 7 fig, 4 tab, 28 ref, 1 append.

Descriptors: *Land use, *Ecological effects, *Marsh plants, *Marsh management, *Vegetation effects, Aquatic plants, Marshes, Wetlands, Envi-

ronmental effects, Water resources development, Vegetation.

The historical development and present distribution of plant species in Kawainui Marsh are outlined. The marsh consists of two main types of vegetation: a bulrush community and a grass community. Transects were established across the two vegetation types. Ground and aerial reconnaissance surveys were made and compared with aerial photographs for mapping vegetation. Plant collections were also made in the marsh and its periphery. Prior to the arrival of the Polynesians, the marsh ponding basin may have looked much as it does now. The Hawaiians used the ponding basin as a fishpond and the higher areas for taro farming. The Europeans maintained the farming area and fishpond and began to use the marsh as a source for irrigation water. In the early 1900's, the marsh was used for cattle grazing. In 1952, Kawainui Canal was constructed along with a weir to maintain the freshwater supply of the marsh. In 1966, the canal was enlarged and a 3-m high levee was constructed. The marsh today aids in flood control and as a receiving pond for sewage effluents. The only perturbations which have seriously affected the marsh are water level manipulations and exotic plant introduction. (See also W87-06103) (Geiger-PTT)
W87-06111

COASTAL ZONE PROBLEMS - A FEDERAL PERSPECTIVE,
Corps of Engineers, Dallas, TX. Southwestern Div.
For primary bibliographic entry see Field 6E.
W87-06152

SOCIAL AND ECONOMIC ASPECTS OF THE RECLAMATION OF ACID SULFATE SOIL AREAS,
International Rice Research Inst., Los Banos, Laguna (Philippines).
For primary bibliographic entry see Field 2G.
W87-06164

WATER QUALITY AND THE NEW FARM POLICY INITIATIVES,
Economic Research Service, Washington, DC.
For primary bibliographic entry see Field 4C.
W87-06399

ARCHAEOLOGY OF THE AK-CHIN INDIAN COMMUNITY WEST SIDE FARMS PROJECT: RESEARCH DESIGN,
Soil Systems, Inc., Phoenix, AZ.
D. A. Phillips, C. D. Breternitz, and W. B. Masse.
Available from the National Technical Information Service, Springfield, VA. Soil Systems Publications in Archaeology, No. 9, Vol. 1. 1986. 91 p, 2 fig, 4 tab, 144 ref.

Descriptors: *Archaeology, *Ak-Chin Indian Community, *Research design, Flood control, Ecosystems, History, Arizona.

This volume describes the research orientation and basic field and laboratory methods to be used during the Ak Chin Archaeological Data Recovery Project. The project is designed to study the cultural resources of the western half of the Ak Chin Community's lands, which are scheduled for intensive agricultural development using waters from the Central Arizona Project. Included is a discussion of the natural and cultural setting of the project, with an emphasis on the Hohokam and historic Papago occupation documented during a prior survey of the area. A problem orientation is defined, in which the basic research theme is Ak Chin as a Holocene ecosystem. A fundamental assumption of this research theme is that Ak Chin has been used as a floodwater farming location for many centuries. The project's problem domains and research questions focus on the physical (geomorphologica), biological, and cultural subsystems within the Ak Chin ecosystem. The regional implications of the research are also considered to be a basic problem domain. The final chapter describes the project's methodological approach. After evaluation of the existing sample, a multiple approach to data recovery was defined. This approach includes: (1) non-site field studies; (2) site re-recording and surface testing; (3) backhoe testing; (4) excavation; and (5) ethnohistoric research. Basic field and in-house analytical procedures are also discussed. (Author's abstract)
W87-06433

STREAM CHANNEL MODIFICATIONS AND RECLAMATION STRUCTURES TO ENHANCE FISH HABITAT,
Wyoming Univ., Laramie. Water Resources Research Inst.
T. A. Wesche.
IN: The Restoration of Rivers and Streams: Theories and Experience, Butterworth Publishers, Boston, Massachusetts. 1985. p 103-163, 23 fig, 176 ref.

Descriptors: *Stream channels, *Land reclamation, *Channeling, *Aquatic habitats, *Ecological effects, *Fish populations, River channels, Channel morphology, Hydraulic properties, Fisheries.

The process of channel modification has played a major, although not always beneficial, role in the development of this country. Land drainage has been necessary to convert swampland into fertile, productive farmland. Dredging of stream bottoms has led to the discovery of precious metals and also to the creation of navigable waterways to transport people and products. Given the sheer magnitude of such river manipulations and an increasing awareness by the public of the environmental ramifications of such acts, it is little wonder that engineers and biologists find themselves continually debating the pros and cons of channel modification. Whether it is called channelization, improvement, alteration, realignment, or stabilization, there are definite impacts to the specific stream reach involved as well as possible upstream and downstream effects. Potentially, the following characteristics of a reach could be altered: channel morphology, channel hydraulics, sediment erosion and deposition processes, water quality, habitat for aquatic biota, the aquatic biota itself, aesthetics, recreation opportunities, riparian communities, and the biota of the riparian communities. From a fisheries standpoint, a most simplistic view of the channelization process and associated impacts could be illustrated by the following flow profile: change in land and/or stream use to change in channel morphology to change in hydraulics to change in habitat to change in population. Generally, the organization of this chapter follows this progression. After a brief review of the basic in-stream components of fish habitat, the impacts of various channel modification activities on habitat diversity are discussed. The concluding section of the chapter concentrates on channel restoration procedures and structures to enhance fish habitat, from a planning aspect as well as from a design and installation approach. (See also W87-06435) (Lantz-PTT)
W87-06440

METHODS FOR DETERMINING SUCCESSFUL RECLAMATION OF STREAM ECOSYSTEMS,
Brigham Young Univ., Provo, UT. Dept. of Zoology.
R. N. Winget.
IN: The Restoration of Rivers and Streams: Theories and Experience, Butterworth Publishers, Boston, Massachusetts. 1985. p 165-192, 6 fig, 7 tab, 76 ref.

Descriptors: *Ecosystems, *Ecological effects, *Streams, Reclamation, Statistical studies, Statistical analysis, Biotic condition index, Biota, Water quality.

Selected methods for the biological evaluation of the success of stream habitat and water quality reclamation and management measures are described. It is assumed the 'desirable state' of a stream ecosystem, the basis of evaluating success of reclamation, closely resembles that encountered under natural, unperturbed, unmodified stream ecosystems. Each stream, although possessing characteristics apparently similar to other streams, is unique. It is also assumed that stream sections classified as similar, based upon physical and chemical stream descriptors, have similar biotic communities. Changes in the physical or chemical environment will elicit adjustments in the biotic community of that environment. Severity and duration of environmental changes determine the magnitude of biotic changes. Changes may include shifts in relative numbers of individuals among species. Following reclamation of a stream's physical and chemical environment, the biotic community should tend to assume the structure and function of a community in a similar unperturbed stream. This characteristic of communities to resume natural structure and function has been defined as the resilience of the community. In an unpublished review, it was concluded that only recently have biological classification systems been proposed that have the capabilities to synthesize a wide variety of ecological parameters and have predictive value for decision making and management. The overall integrative approach of two of these recent classification systems, offers much promise for the interpretation and application of data from benthic macroinvertebrate samples. The purpose of the biotic condition index (BCI) is to provide a methodology for evaluating existing conditions of stream macroinvertebrate communities based upon their biological potential. Evaluations are based upon water quality, physical habitat, and aquatic biota data. The statistical methodology used in the BCI: (1) is sensitive to all types of environmental stress; (2) is applicable to various types of streams; (3) gives a linear assessment from unstressed to highly stressed conditions; (4) is independent of sample size providing the sample contains a representative assemblage of species; (5) is based upon water quality and physical habitat data readily available or easily acquired; and (6) meshes readily with existing stream habitat and water quality management programs. (See also W87-06435) (Lantz-PTT)
W87-06441

WATER AND ENVIRONMENTAL STUDIES OF THE PROPOSED ALTO SINU HYDROELECTRIC POWER PROJECT IN COLOMBIA,
Dames and Moore, Bethesda, MD.
R. C. Tucker.
IN: Symposium on Tropical Hydrology and 2nd Caribbean Islands Water Resources Congress, Proceedings of the International Symposium, May 5-8, 1985, San Juan, Puerto Rico. p 169-172, 1 ref.

Descriptors: *Environmental effects, *Hydroelectric power, *Water resources development, *Colombia, *Rio Sinu, Watersheds, Ecological effects, Forest watersheds, Environmental impact statement.

The primary purpose of the proposed Alto Sinu Project on the Rio Sinu in northwestern Colombia is to produce hydroelectric power for the national grid. The project includes Urra I on the Sinu River, and Urra II located 67 km upstream from Urra I. Urra II would inundate 734 sq km of tropical rain forest, with a reservoir volume of 43.1 times 10 to the 9th power cu m; Urra I would inundate 95 sq km, with a reservoir volume of 2.7 times 10 to the 9th cu m. The project would be constructed in one of the few remaining large virgin tropical forested watersheds in the world. The environmental assessment consisted of two phases. Phase I involved an analysis of the Urra project by a multidisciplinary team of specialists with expertise in terrestrial ecology, forest resources, aquatic ecology, hydrology, water quality, and related disciplines. It was realized early in Phase I that there was very little site-specific information available for the Urra project area and for the entire subject of reservoir impoundments in uncleared tropical rain forests. Almost none of the world's major reservoirs have been constructed in tropical forested regions. Accordingly, a Phase II impact assessment program had to be developed with these points in mind. The final Phase I report, presented in May 1981, focused on (1) the baseline environment of the study area, as defined in previous studies; (2) potential key issues of concern; and (3) recommended Phase II studies to support better analyses of these issues and assessment of their

impacts. Phase II of the environmental study consisted of six tasks and resulted in an environmental assessment report, published in February 1983. Subsequently, various special studies, including a river/reservoir water quality modeling program, have been undertaken. This paper presents an overview of the project, including a discussion of environmental implications, recommended programs for mitigation, and future studies. (See also W87-06455) (Lantz-PTT)
W87-06490

AQUATIC BIOTA ASSOCIATED WITH CHANNEL STABILIZATION STRUCTURES AND ABANDONED CHANNELS IN THE MIDDLE MISSOURI RIVER,
Iowa Cooperative Fishery Research Unit, Ames.
For primary bibliographic entry see Field 4A.
W87-06524

7. RESOURCES DATA

7A. Network Design

SECONDARY CIRCULATION IN NATURAL STREAMS,
Illinois State Water Survey Div., Champaign. Surface Water Section.
For primary bibliographic entry see Field 2E.
W87-06100

MARINE POLLUTION MONITORING CONCERNS: SUMMARY REPORT FOR THE STATE OF HAWAII,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
L. S. Lau, E. S. Akazawa, and G. C. Richardson.
IN: Collected Reprints, Volume V: 1978-1981, June 1984. Water Resources Research Center, Honolulu, Hawaii. p 264-267, 5 ref.

Descriptors: *Monitoring, *Water pollution prevention, *Water quality management, *Marine environment, *Hawaii, Water pollution, Water pollution control, Coastal zone management, Bioindicators, Bioassays, Coral reefs, Management planning.

Representatives of state, county and local agencies in the state of Hawaii reviewed the marine pollution monitoring programs at the November 18 sessions. Four main points were stressed as a result of the discussions. The warm-water, oceanic, coral ecosystem setting of Hawaii and the Pacific islands are substantially different from the continental shelf coastal environment, and require local in-situ monitoring tailored to the coral ecosystem, insular environment, and ocean resources development. The Hawaiian and Pacific islands should be considered as a subregion and be supported by more adequate funding than at the current level of less than 1% of federal funding. The experience gained from Hawaii's ecosystem approach to water quality management is offered to the region and to the Nation. The nine high-priority research needs for maine pollution monitoring are: applicability of marine water quality criteria to Hawaii and Pacific islands, selection of indicator organisms for the fish, mollusk, and crustacean categories for toxicity bioassays; Natural vs. induced changes of a balanced indigenous popultion within the zone of initial dilution; toxic substances and their biological effects; improved ecological monitoring techniques; microbial and viral research needs; coral protection from silt by coastal land zoning; pollution transport model for oceanic islands; and ocean management planning. (See also W87-06103) (Geiger-PTT)
W87-06119

MICROBIOLOGICAL SAMPLING IN THE ASSESSMENT OF GROUNDWATER POLLUTION,
Robert S. Kerr Environmental Research Lab., Ada, OK.
J. F. McNabb, and G. E. Mallard.
IN: Groundwater Pollution Microbiology, John Wiley and Sons, New York, New York, 1984. p 235-260, 8 fig, 64 ref.

Descriptors: *Water sampling, *Microbiological studies, *Sample preparation, *Groundwater pollution, *Water quality control, Geohydrology, Sampling, Groundwater quality, Microorganisms.

In many microbiological studies of groundwater and subsurface environments, little attention has been paid to securing good samples. Many papers in the literature give little information regarding the sampling methods and the characteristics of the wells. Further, there is a tendency for investigators to compare data from different types of samples. Geohydrologic conditions are of overriding importance in designing and conducting subsurface microbiological sampling programs. Both the type of equipment used and the location of sampling points are dependent on site-specific conditions. The type of sample collected, whether solid or water, is determined by the purpose of the study. Groundwater samples may be ideal in studies of the movement of pathogens or indicator organisms from waste-disposal sites or in investigations using microorgansism as tracers. In contrast, for studies of microorganisms indigenous to an aquifer, core samples probably provide more information. In either case, the microbiologist will face a considerable challenge in collecting representative and uncontaminated samples of either subsurface solids or water. Microbiological data obtained from either type of sample should be interpreted with caution. Samples of subsurface solids provide information about one point in three-dimensional space and can be obtained only once because the sampling process is inherently disruptive. Water samples can be obtained from the same well repeatedly; however, this information may not adequately reflect conditions in the aquifer. (See also W87-06201) (Lantz-PTT)
W87-06212

GROUNDWATER CONTAMINATION: DATA ANALYSIS AND MODELING,
Texas Univ. Health Science Center at Houston. School of Public Health.
For primary bibliographic entry see Field 5B.
W87-06213

CRITICAL ASSESSMENT OF FORECASTING IN WATER QUALITY GOALS IN WESTERN WATER RESOURCES MANAGEMENT.
American Water Resources Association, Bethesda, MD.
Proceedings of a Symposium held in Seattle, Washington, June 11-13, 1984. 1985. 181 p. Edited by John J. Cassidy and Dennis P. Lettenmaier.

Descriptors: *Forecasting, *Water management, *Flood forecasting, *Water yield, *Water resources development, Symposium, Rivers, Hydroelectric power, Data acquisition, Information exchange.

These proceedings arose from AWRA's first regional symposium, 'A Critical Assessment of Forecasting in Western Water Resources Managment' held at the Sheraton Hotel in Seattle, June 11-13, 1984. The topic of the symposium was timely, following severe 1983 flooding in the Colorado River and Salt Lake City area. These episodes focused attention on a number of issues related to forecasting methods, data acquisition, and the integration of forecasts and forecast uncertainty into the operation of large water resource systems. Other regional issues, such as the proposed second stage development of the Columbia River Federal Reclamation Project, and the electric power rate implications of power demand forecasting errors, emphasize the importance of demand forecasting, and methods for estimating and accommodating demand forecasting errors, as well. The symposium, organizers, therefore, sought to provide a mix of papers addressing runoff and demand forecasting techniques, with emphasis on applications, as well as methods. (See also W87-06239 thru W87-06257) (Lantz-PTT)
W87-06238

LONG-RANGE STREAMFLOW FORECASTING: A STATE AGENCY PERSPECTIVE,
California State Dept. of Water Resources, Sacramento. Div. of Planning.
H. J. Peters.
IN: A Critical Assessment of Forecasting in Water Quality Goals in Western Water Resources Management, Proceedings of a Symposium held in Seattle, Washington, June 11-13, 1984. 1985. p 3-10, 2 fig, 2 tab, 11 ref.

Descriptors: *Streamflow forecasting, *Streamflow, *Forecasting, *Water resources development, *California, Management planning, Watersheds, Long-term planning, Runoff.

The California Department of Water Resources has searched for a method of long-range precipitation forecasting since 1972. In the first three years, forecasts were made based on the methods of Dr. Irving P. Krick. In later years, methods developed at Scripps Institution of Oceanography, were the basis of forecasts. Comparison of forecasts with the actual precipitation gave promise of usable skill in the early years and in later years produced positive skill scores for predicting actual terciles (high, medium, or low). Skill scores for watersheds of the Sierra Nevada over a seven-year period range from 0.46 to 1.00. The pursuit of an ability to forecast precipitation, even by tercile, up to a year in advance is demonstrated to be of value in water supply operation and helpful in planning construction or repair of facilities. The use of volumetric forecasts of snowmelt runoff based on snow surveys has been augmented by climate statistics to identify courses of action and attendant risks in California as an interim measure while long-range forecast skills are developed. The writer believes that sufficient skill will be developed for use in water supply operations, but has not identified a measure of skill that would be acceptable for operational use. (See W87-06238) (Author's abstract)
W87-06239

STATE OF THE ART IN HYDROLOGIC FORECASTING: WHAT NEXT,
For primary bibliographic entry see Field 2A.
W87-06240

RIVER BASIN WATER QUALITY MONITORING NETWORK DESIGN,
Old Dominion Univ., Norfolk, VA. Dept. of Civil Engineering.
F. S. Tirsch, and J. W. Male.
IN: Options for Reaching Water Quality Goals, Proceedings of the Twentieth Annual Conference of the American Water Resources Association Symposium, Washington, DC., August 15, 1984. 1985. p 149-156, 11 fig, 1 tab, 3 ref.

Descriptors: *River basins, *Water quality control, *Monitoring, *Network design, *Surface water, *Millers River, *Massachusetts, Statistical analysis, Regression analysis, Mathematical studies, Streamflow.

Design of a surface water quality monitoring network is confounded by the paradox that the statistical parameters controlling the optimality of a monitoring network are often the unknowns that the network is being designed to estimate. The usual resolution of the paradox is to use an iterative approach. Initial design may be arbitrary or based on experience and is refined over time in successive 'iterations.' A procedure that can be used in the 'next iteration' of network design utilizes multivariate linear regression techniques and relies on the regression corrected coefficient of determination, R to the 2nd power, as a measure of network reliability. Spatial design is examined to determine how reliably water quality may be estimated at specified locations given water quality data at monitored locations in the basin. Temporal design is examined to determine how reliably water quality may be estimated given different sampling frequencies. The spatial and temporal analyses are combined to form the basin space-time trade-off. For the Millers River, Massachusetts, the trade-off for monitoring mean daily streamflow (a substitute for a water quality parameter) was developed. The trade-off indicated that for the Millers River basin the addition of stations would have little impact on monitoring precision. Significant changes in preci-

sion result from changes in monitoring frequency. (See also W87-06270) (Author's abstract)
W87-06285

SITE-SPECIFIC WATER QUALITY CRITERIA FROM IN-STREAM MONITORING DATA,
American Electric Power Service Corp., Columbus, OH. Environmental Engineering Div.
For primary bibliographic entry see Field 5A.
W87-06315

RESILIENCE OF A STATISTICAL SAMPLING SCHEME,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
S. Rouhani, and M. B. Fiering.
Journal of Hydrology JHYDA7, Vol. 89, No. 1/2, p 1-11, December, 1986. 1 fig, 3 tab, 21 ref. NSF Grant ECE-8503897.

Descriptors: *Algorithms, *Covariance function, *Sampling, *Statistics, *Hydrology, Noise, Water quality data, Random sampling, Regret analysis.

Most statistical sampling algorithms on hydrologic random fields assume that the new measurements will agree reasonably well with their predicted values. This implies the stationarity of the estimated covariance function. The reliability of the variance reduction analysis statistical algorithm was tested by generation of noisy input data followed by comparison of the results of sampling from these data to sampling from the unperturbed data. These comparisons and a related regret analysis revealed that the effects of the noisy data are primarily accommodated by adjustments to the covariance function parameters, whereas selected sets showed a high degree of resilience. Variance reduction analysis seems to be a reliable method for maximizing information by sampling random fields with an unstable parameter space, but a resilient action space. (Author's abstract)
W87-06374

STOCHASTIC MODEL OF RAINFALL INTERCEPTION,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2B.
W87-06379

SPATIAL VARIABILITY OF WATER MOVEMENT IN SOIL: USE OF A TRACER AND GEOSTATISTICAL ANALYSIS (VARIABILITIE SPATIALE DU TRANSFERT DE L'EAU DANS LE SOL: UTILISATION DU TRACAGE ET ANALYSE GEOSTATISTIQUE),
Avondale Coll. of Advanced Education, Cooranbong (Australia). Dept. of Science.
For primary bibliographic entry see Field 2G.
W87-06381

DEVELOPMENT OF A FOREST WATER RESOURCES INVENTORY FOR PUERTO RICO,
Georgia Univ., Athens. School of Forest Resources.
W. L. Nutter, and R. Studenmund.
IN: Symposium on Tropical Hydrology and 2nd Caribbean Islands Water Resources Congress, Proceedings of the International Symposium, May 5-8, 1985, San Juan, Puerto Rico. p 36-38, 1 ref.

Descriptors: *Water resources development, *Resources management, *Puerto Rico, *Water resources data, *Data collections, *Forests, Water management, Watersheds, Costs, Economic aspects, Data acquisition, Physical properties, Chemical properties.

A number of water resources studies for Puerto Rico have been completed or are currently underway by various Federal and Commonwealth agencies. The studies have identified water as a critical resource which, without proper management and conservation, will limit economic and social development of the island. The forests of Puerto Rico occupy for the most part those areas that receive the greatest rainfall and therefore serve as the natural 'water supply reservoir' for the island. It is within this context that a management policy for the Commonwealth Forests as well as other forested areas may be included in an island-wide water plan. The development of an island-wide plan for water resources management must consider the role of land use practices as they affect the quantity, quality, and timing of streamflow. Potentially, all management practices applied to the landscape can influence physical, chemical, and biological characteristics of water. Using the basic inventory data and combining it with land use and sediment prediction estimating procedures similar to those used on National Forest lands, a comparison of predicted sediment yields can be made between watersheds. These estimates can be used for comparison to assess the relative impact of various activities before implementation. The cost for implementing the forest water resource inventory is relatively low. It is estimated that approximately one-person year would be required to do all the map and data analyses for the DNR Forest Service lands in the Central Mountain Region of Puerto Rico. (See also W87-06455) (Lantz-PTT)
W87-06463

GENERAL HYDROLOGY AND WATER QUALITY OF LAYOU RIVER IN DOMINICA, BUCCAMENT RIVER IN ST. VINCENT, AND TROUMASSEE RIVER IN ST. LUCIA, BRITISH WEST INDIES,
For primary bibliographic entry see Field 2E.
W87-06465

HYDROLOGICAL DESIGN IN PRESENCE OF LIMITED DATA,
E. Garcia, and J. Turbides.
IN: Symposium on Tropical Hydrology and 2nd Caribbean Islands Water Resources Congress, Proceedings of the International Symposium, May 5-8, 1985, San Juan, Puerto Rico. p 73-75, 2 fig, 4 tab, 4 ref.

Descriptors: *Hydrologic models, *Data interpretation, *Water resources development, *Rio Yuna, *Dominican Republic, River basins, Hydroelectric power, Precipitation, Rainfall-runoff relationships, Streamflow, Floods.

In countries where it does not exist, a long standing tradition in the use of water resources lacks decision making processes for hydrologic design using short-term hydrometeorological data. Generally in these cases, it is not possible to use conventional tools, but rather the use of techniques based on sophisticated analysis which allow for reasonable results is required. Described here are the procedures for the determination of hydrological parameters for the prefeasibility design of the Hydroelectric Project El Torito-Los Veganos located in Rio Yuna basin in the Dominican Republic. The procedures discuss the following topics: (1) basin description; (2) precipitation analysis; (3) rainfall-runoff models; (4) daily streamflow reconstruction; (5) operation of the hydroelectric system; and (6) probable maximum flood calculation. (See also W87-06455) (Lantz-PTT)
W87-06470

LAKE HURON ROTIFER AND CRUSTACEAN ZOOPLANKTON, APRIL-JULY, 1980,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 2H.
W87-06580

STRATEGY FOR CONCURRENTLY MONITORING THE PLANT WATER POTENTIALS OF SPATIALLY SEPARATED FOREST ECOSYSTEMS,
Alberta Univ., Edmonton. Dept. of Botany.
W. L. Strong, and G. H. La Roi.
Canadian Journal of Forest Research CJFRAR, Vol. 16, No. 2, p 346-351, April 1986. 5 fig, 1 tab, 22 ref. Employment Canada Projects 2177 WP3 and 2130 XP1, Boreal Institute for Northern Studies Grant 55-30119, Alberta Environment Research Trust Grant TO460, Alberta Environment RMD-80/35A and NSERC (Canada) A-7238.

Descriptors: *Plant water potentials, *Water stress, *Soil water, Forestry, Ecology, Groundwater, Monitoring, Diurnal water potentials, Soil matrix potentials, Black spruce, Jack pine, Trees, Roots, Percolation, Rainfall.

A technique for estimating plant water potentials in plant communities was used in six forest stands representing a jack pine and black spruce successional sequence. A set of 31 plants composed of 16 species were measured at 4-day intervals from early May to late August 1982. The six stands had similar patterns of summer plant water potentials with greatest differentiation among species occurring during periods of maximum water stress. Plant water potentials varied more in jack pine stands on sand than in black spruce stands on organic soil. Shallow-rooted ericaceous and (or) evergreen species had the widest range of water potentials during summer, whereas deep-rooted Alnus crispa had the narrowest range. Maximum morning water potentials reached -3.1 MPa. All species had fine roots within the upper 20 cm of the soil, but some species of the Jack Pine Series had roots to 230 cm depth. Soil moisture was usually more available in the upper 20 cm and below 60 cm in mineral soils; the lower amount of soil moisture at middle depths resulted from depletion by plants and lack of downward percolation of precipitation in 1982. (Author's abstract)
W87-06603

7B. Data Acquisition

PRACTICAL EXPERIENCES WITH A NEW ON-LINE BOD MEASURING DEVICE,
Gesamthochschule Siegen (Germany, F.R.). Inst. fuer Mechanik und Regelungstechnik.
M. Kohne.
Environmental Technology Letters ETLEDB, Vol. 6, No. 12, p 546-555, December 1985. 9 fig, 12 ref.

Descriptors: *Wastewater treatment, *Biochemical oxygen demand, *Measuring instruments, *Process control, Wastewater facilities, Performance evaluation.

The principle of operation and measurement method are described for the new on-line biochemical oxygen demand (BOD) measurement device developed Siepmann and Teutscher of Germany (the BOD-M3), and practical experiences are presented and discussed. Results are obtained within 3 minutes using the BOD-M3, and were in very good agreement with conventional sample tests. Future areas of application of the BOD-M3 in control engineering are indicated. (Rochester-PTT)
W87-05931

IMPROVED GAS CHROMATOGRAPHIC METHOD FOR THE MEASUREMENT OF HYDROXYLAMINE IN MARINE AND FRESH WATERS,
Oregon State Univ., Corvallis. School of Oceanography.
J. H. Butler, and L. I. Gordon.
Marine Chemistry MRCHBD, Vol. 19, No. 3, p 229-243, July 1986. 3 fig, 4 tab, 37 ref. NSF Grant OCE-8409069.

Descriptors: *Sample preparation, *Cycling nutrients, *Gas chromatography, *Chromatography, *Measuring instruments, *Hydroxylamine, Chemical analysis, *Chemical reactions, Oxidation, Nitrous oxide, Hydrogen ion concentration, Salinity, Chemical properties, Standard deviation, Mathematical studies, Sensitivity analysis, Comparison studies, Brackish water, Seawater, Freshwater.

An improved method for the analysis of hydroxylamine at nanomolar levels involves oxidation by Fe(III) and the subsequent measurement of nitrous oxide by electron-capture gas chromatography. The relationship between the pH and salinity of natural waters and the conversion of hydroxylamine to nitrous oxide by Fe(III) is defined, the rates of the reaction are evaluated, and the effects of dissolved O2, Cu(II) and Hg(II) on the reaction

are investigated. The method is linear to more than 300 nM and the standard deviation for a single measurement is 1 nM in the 0-40 nM range, thus exceeding the sensitivity of the spectrophotometric methods by almost an order of magnitude. This method eliminates the effects of pH and salinity that have burdened an earlier gas chromatographic approach, making possible the investigation of this labile substance not only in seawater, but in fresh and brackish waters as well. (Author's abstract)
W87-06057

AQUEOUS SURFACE CHEMISTRY: ASSESSMENT OF ADSORPTION CHARACTERISTICS OF ORGANIC SOLUTES BY ELECTROCHEMICAL METHODS,
Institut Rudjer Boskovic, Zagreb (Yugoslavia). Center for Marine Research.
B. Cosovic.
IN: Chemical Processes in Lakes, John Wiley and Sons, New York, New York. 1985. p 55-80, 14 fig, 6 tab, 38 ref.

Descriptors: *Chemical properties, *Electrochemistry, *Organic compounds, *Adsorption, *Adriatic Sea, *Path of pollutants, Groundwater, Surface water, Electrodes, Electrical properties, Fate of pollutants.

Electrochemical methods, based on the measurement of adsorption phenomena at the mercury electrode, are direct and nondestructive and therefore convenient for the research and control of surface-active material in natural waters. The two different techniques, measurement of polarographic maxima and capacity-current measurement, were developed and applied to the analysis of surface-active substances in freshwater and marine samples. The approximate characterization of predominant groups of surface-active compounds is made through a comparison of the shape and the intensity of the electrochemical response obtained in natural samples with those of different model substances. Humic substances were predominant surface-active material in river water and groundwater samples. Field observations of surface-active substances in the Adriatic Sea by electrochemical methods and experiments with phytoplankton culture media demonstrated that the content and the composition of surface-active material in the sea are closely related to the biological activity of the sea. The enrichment factors in the sea surface film were higher for hydrophobic lipid material than for more soluble wet surfactants. Electrochemical studies have strengthened the role of lipid material in adsorption processes in the sea. Preliminary investigations of the interaction between surfactants and cadmium at the electrode/water interface showed that (1) most naturally occurring surfactants have little effect on the mass and charge transfer process at the electrode surface; (2) synthetic compounds, like commercial detergents, slow down the kinetics of the processes at the interfaces; and (3) some organic coatings at the surface, as for example, unsaturated fatty acids, may interact with metal ions resulting in an enrichment of metal ions in the organic layer at the surface. (See also W87-06126) (Author's abstract)
W87-06129

SIMPLE, LOW-COST METHOD TO COLLECT UNDISTURBED CORES OF ACID SULFATE SOIL PROFILES FOR THE STUDY OF WATER AND SOLUTE MOVEMENT DURING RECLAMATION AND USE FOR WETLAND RICE,
International Rice Research Inst., Los Banos, Laguna (Philippines).
L. N. Sen.
IN: Proceedings of the Bangkok Symposium on Acid Sulphate Soils, Second International Symposium on Acid Sulphate Soils, Bangkok, Thailand, January 18-24, 1981. ILRI Publication 31, 1982. p 381-388, 5 fig, 5 ref.

Descriptors: *Soil profiles, *Acidic soils, *Wetlands, *Rice, *Soil tests, Land reclamation, Acid sulfates, Lysimeters, Soil water, Sample preparation.

A simple, low-cost method was developed to collect, transport and instrument undisturbed soil profile cores. This method was used to test different combinations of measures to reclaim acid sulfate soils for wetland rice. The cores are large enough to accommodate several rice hills until maturity. Oil drums of 60-cm inside diameter and 90-cm length were used as lysimeter cylinders. Their surfaces were coated with epoxy paint to prevent contamination of the soil material. These cylinders were inserted into the undisturbed soil by pressure aided by excavation and trimming around the cutting edge. Soil profiles to 0.85-cm depth were obtained. The filled cylinders were brought to the experiment station after sealing their bottoms. Perforated PVC drainage pipes, capacitive soil moisture probes and soil moisture sampling filters were installed at different depths to drain water from the profiles, to measure the changes in soil moisture content during the oxidation process and to monitor the composition of soil solutions during reclamation and crop growth. The present paper only describes the design of the lysimeter drums and the methods of collection and instrumentation. (See also W87-06162) (Lantz-PTT)
W87-06186

CHARACTERIZATION OF SPILLED OIL SAMPLES: PURPOSE, SAMPLING, ANALYSIS AND INTERPRETATION.
Institute of Petroleum, London (England). Marine Environment Committee.
For primary bibliographic entry see Field 5A.
W87-06237

MODULAR HYDROLOGIC DATA ACQUISITION AND REAL-TIME COMMUNICATIONS INSTRUMENTATION,
Geological Survey, NSTL Station, MS.
R. H. Billings, and V. J. Latkovich.
IN: A Critical Assessment of Forecasting in Water Quality Goals in Western Water Resources Management, Proceedings of a Symposium held in Seattle, Washington, June 11-13, 1984. 1985. p 17-23, 5 fig, 2 tab.

Descriptors: *Hydrologic data, *Data acquisition, *Instrumentation, *Computers, Information exchange, Communication.

The U.S. Geological Survey is developing a capability for providing ready field data collection and real-time data transmission support instrumentation suitable for short-term hydrologic and demand forecasting programs. A modular microprocessor-based Adaptable Hydrologic Data Acquisition System (AHDAS) will provide the necessary foundation. AHDAS equipment will be capable of being fitted, within a minimum timeframe, for operation with any combination of environmental sensors and data transmission systems. The adaptable hardware features of AHDAS will be complemented by its field-programsbility. A wide range of 'intelligent' operating schemes will provide for multiple-user operation, sensor and sampling control, internal data manipulation, and real-time communications control. (See also W87-06238) (Author's abstract)
W87-06241

SNOTEL DATA ACQUISITION SYSTEM: A TOOL IN RUNOFF FORECASTING,
Soil Conservation Service, Portland, OR.
A. G. Crook.
IN: A Critical Assessment of Forecasting in Water Quality Goals in Western Water Resources Management, Proceedings of a Symposium held in Seattle, Washington, June 11-13, 1984. 1985. p 25-30, 4 fig, 2 tab, 6 ref.

Descriptors: *Data acquisition, *SNOTEL, *Runoff, *Forecasting, Computers, Snowpack, Snowmelt, Telemetry, Water resources development, Data interpretation.

The U.S. Department of Agriculture, Soil Conservation Service's SNOTEL data acquisition system has been in operation in the western United States since 1977. Its primary function is to sense and transmit hydrometeorological data from remote mountainous terrain. Data are telemetered via VHR radio using meteor scattered technology. The standard sensor configuration consists of snowpack water equivalent, total accumulated precipitation, and air temperature. Sites are interrogated once daily and additional polls can be conducted. Second generation electronics offer microprocessor capability which substantially enhances remote site functions. System performance is measured in three categories: the reliability of receiving data, the diurnal stability of data, and the accuracy of sensors and data transmission. SNOTEL data are retrieved by the computer terminal for a wide variety of uses. The principal use by the Soil Conservation Service is in forecasting seasonal snowmelt runoff volumes. These forecasts are generated for irrigation water management and reservoir operations. However, the data are also widely used in assessing hazards such as flooding and snow avalanches. The magnitude of flood potential is determined by National Weather Service hydrologists. (See also W87-06238) (Author's abstract)
W87-06242

AUTOMATED DATA ACQUISITION TECHNIQUES FOR FORECASTING PACIFIC NORTHWEST RIVERS,
National Weather Service, Portland, OR. Northwest River Forecast Center.
P. A. Pasteris, and R. K. Hartman.
IN: A Critical Assessment of Forecasting in Water Quality Goals in Western Water Resources Management, Proceedings of a Symposium held in Seattle, Washington, June 11-13, 1984. 1985. p 31-43, 13 fig, 12 ref.

Descriptors: *Data acquisition, *Rivers, *Forecasting, *Data transmission, *Columbia River, Data collections, Computers, Databases.

The Columbia River is one of the world's most highly managed rivers. The forecasting which is a part of that management uses extensive data, most of it received and processed automatically from a wide variety of sources. Data collection systems used include teletype, land-based radio, telephone (audio or ASCII), meteor burst, and satellite relay systems. A netowrk of minicomputers in the National Weather Service Forecast Offices (WSFO's) in the Pacific Northwest allows local data display as well as transmission of information to a regional database for use by the Northwest River Forecast Center (NWRFC). The Columbia River Operational Hydromet Management System (CROHMS) regional database provides a key medium for data exchange by which the NWRFC obtains the interagency data required for forecasting. Hydrologic data codes such as the Standard Hydrologic Exchange Format (SHEF) and the Columbia Basin Teletype (CBTT) code facilitate data communications interpreted by both man and machine. The Automation of Field Operations and Services (AFOS) of the National Weather Service (NWS) provides capability for on-site editing and rapid dissemination of forecasts which are then provided to users through NWS state offices. Finally, the NWS-supported Automated Local Evaluation in Real-Time (ALERT) allows rapid local response in Flash Flood areas. (See also W87-06238) (Author's abstract)
W87-06243

EFFECTS OF RUNOFF FORECASTING ON COLORADO RIVER OPERATIONS AT HOOVER DAM,
Bureau of Reclamation, Boulder City, NV. Lower Colorado Region.
For primary bibliographic entry see Field 6B.
W87-06244

VALUE OF RAINFALL ESTIMATES IN RESERVOIR MANAGEMENT FOR FLOOD CONTROL,
Oklahoma Climatological Survey, Norman.
A. Eddy.
IN: A Critical Assessment of Forecasting in Water Quality Goals in Western Water Resources Management, Proceedings of a Symposium held in Seattle, Washington, June 11-13, 1984. 1985. p 55-61, 9 fig, 7 ref. NOAA Contract No. NA79DA-C-

00012, and Oklahoma Water Resources Board Contract No. N200011.

Descriptors: *Rainfall-runoff relationships, *Reservoir operation, *Flood control, Simulation analysis, Model studies, Hydrologic models, Rainfall, Water management.

Three pieces of technology have developed to the point where detailed rainfall information can now be made available to reservoir operators in close to real time so that they can plan the pre-release of water to mitigate flooding and still not waste this valuable resource unnecessarily. This technology comprises: weather radar, microprocessors, and communications. As a consequence it is time both to implement and test such a system and to assess its value to the user. Reported on is the progress of an Oklahoma project which is well on the way to accomplishing both the implementation and the evaluation. The particular focus of this evaluation is on the expected worth of skillfully processed and timely weather information to this particular customer class. (See also W87-06238) (Author's abstract)
W87-06245

WATER QUALITY MAPPING WITH SIMULATED LANDSAT THEMATIC MAPPER DATA,
Ames Lab., IA.
E. M. Horn, and L. A. Morrissey.
IN: Options for Reaching Water Quality Goals, Proceedings of the Twentieth Annual Conference of the American Water Resources Association Symposium, Washington, DC., August 15, 1984. 1985. p 157-166, 3 fig, 5 tab, 14 ref. NASA Contract No. NAS 2-11101.

Descriptors: *Water quality control, *Path of pollutants, *LANDSAT, *Data interpretation, *Data acquisition, *Remote sensing, Statistical analysis, Temperature, Turbidity, Conductivity, Hydrogen ion concentration, Suspended solids, Regression analysis, Simulation analysis.

The ability of simulated LANDSAT Thematic Mapper (TMS) data to discriminate select water quality constituents was evaluated. Temperature, suspended solids, turbidity, conductivity, pH, and depth were measured in situ at 25 predesignated sample sites concurrent with a TMS overflight. Multiple and stepwiae regressions were performed to identify optimal band combinations for each constituent. Regression equations were assessed with respect to their coefficient of determination and statistical significance. Significant regressions were obtained for conductivity (salinity), turbidity, and suspended solids, while statistical results for pH, temperature, and depth did not meet all significance criteria. Regression equations were developed for these three constituents using various band combinations: all seven TM bands for suspended solids, bands 1-4 and 6 for conductivity, and four principal components for turbidity. The best single band for discriminating select water quality constituents was also identified through the use of a stepwise regression procedure: TM band 4 for turbidity and conductivity, TM band 3 for suspended solids. Confidence intervals about the mean regression point were calculated to assess the robustness of the regressions. The intervals at the mean were + or - 3.43 mg/L for suspended solids, + or - 10.25 micromilliohms/cm for conductivity, and + or - 3.35 NTUs (nephelometer turbidity units) for turbidity. (See also W87-06270) (Author's abstract)
W87-06286

USE OF AERIAL PHOTOGRAPHY IN DETECTION AND CHARACTERIZATION OF NONPOINT SOURCES OF POLLUTION,
Environmental Photographic Interpretation Center, Warrenton, VA.
J. D. Simons.
IN: Options for Reaching Water Quality Goals, Proceedings of the Twentieth Annual Conference of the American Water Resources Association Symposium, Washington, DC., August 15, 1984. 1985. p 167-174, 7 tab, 26 ref.

Descriptors: *Aerial photography, *Water pollution control, *Path of pollutants, *Nonpoint pollution sources, *Virginia, Watersheds, Water quality control, Groundwater pollution, Computer programs, Digital computers.

Since 1973, the EPA/Environmental Photographic Interpretation Center (EPIC) has used aerial photography in numerous water quality related projects, including many nonpoint source pollution studies. This paper summarizes earlier efforts to detect nonpoint sources and gives a more detailed account of recent studies done on two lake watersheds in Virginia. Many of the studies performed at EPIC in which nonpoint sources are detected are specifically tailored to the needs of the requestor. Some of the earlier studies were part of a point source pollution inventory or a detailed land use study from which the nonpoint sources of pollution could be detected. More recently, in support of the EPA Chesapeake Bay Program, agricultural practices in three watersheds were analyzed in detail in conjunction with water quality analyses. In addition, detailed land use and nonpoint source pollution inventories were performed on Smith Mountain Lake (1978) and Lake Chesdin (1982), both in Virginia. These studies were initiated because of deteriorating water quality in both lakes. The land use in both of these studies was digitized using EPIC's Image Analysis System, a computerized mapping and imagery analysis system. This system permitted the 851,000-acre Lake Chesdin watershed study to be completed in a five-month time frame. These studies are signficant in that they demonstrate how aerial photography can be used to accomplish a nonpoint source pollution inventory in a relatively short period of time, and with a greater accuracy than can be obtained with alternative methods now in use. (See also W87-06270) (Author's abstract)
W87-06287

WATER QUALITY MONITORING FOR THE TACHIA RIVER IN TAIWAN, REPUBLIC OF CHINA,
Ministry of Economic Affairs, Taipei (Taiwan). Water Resources Planning Commission.
J. J. Lin, H. C. Liu, S. J. Chen, and I. L. Cheng.
IN: Options for Reaching Water Quality Goals, Proceedings of the Twentieth Annual Conference of the American Water Resources Association Symposium, Washington, DC., August 15, 1984. 1985. p 175-181, 6 fig, 1 tab, 8 ref.

Descriptors: *Water quality control, *Tachia River, *Taiwan, *Water pollution sources, *Path of pollutants, Pesticides, Agricultural runoff, Irrigation, Toxicity, Phytoplankton, Eutrophication, Sedimentation.

The Tachia River located in central Taiwan, is one of the most valuable rivers for water resources development in Taiwan. The water of this river has been regulated for hydropower (1000 MW), irrigation and public water supply by constructing a series of reservoirs along the river. In recent years, due to the excesssive use of pesticides and chemical fertilizers in orchards along the upper reaches of the river, toxic substances were detected and phytoplankton and nutrient concentrations of the water were found to rise gradually. In order to know the extent of pollution and propose suitable control acts, a long term water quality monitoring project has been cosponsored by Taiwan Power Company (Taipower) and Water Resources Planning Commission (WRPC) since early 1983. Preliminary results show that the water in Techi reservoir became thermally stratified during summer. It was also observed that the water in the upper portion of the reservoir appears reddish brown in color during the algae bloom season, creating the so-called red tide phenomenon. Moreover, this reservoir has become an eutrophic lake as evidenced by its very low transparency and high nutrient concentration. In the future, to assure a proper assessment of eutrophication, the continuous monitoring work and mathematical modeling of water quality are necessary. (See also W87-06270) (Author's abstract)
W87-06288

SCREEN DEVICE TO ELIMINATE 'FLOATERS' IN DAPHNIA MAGNA TOXICITY TESTS,
Battelle Columbus Div., OH.
For primary bibliographic entry see Field 5A.
W87-06359

PUMPING TEST USING LARGE-DIAMETER PRODUCTION AND OBSERVATION WELLS,
Komenskeho Univ., Bratislava (Czechoslovakia). Dept. of Hydrogeology.
For primary bibliographic entry see Field 2F.
W87-06385

ANALYSES OF CHLORINATED STYRENES IN ENVIRONMENTAL SAMPLES USING NEGATIVE ION CHEMICAL IONIZATION MASS SPECTROMETRY,
Senter for Industriforskning, Oslo (Norway).
For primary bibliographic entry see Field 5A.
W87-06393

APPLICATION OF 222-RN IN MEASURING GROUNDWATER DISCHARGE TO THE MARTHA BRAE RIVER, JAMAICA,
Lamont-Doherty Geological Observatory, Palisades, NY.
For primary bibliographic entry see Field 2F.
W87-06468

RECENT DEVELOPMENTS IN HYDROLOGIC INSTRUMENTATION,
Geological Survey, NSTL Station, MS.
V. J. Latkovich.
IN: Symposium on Tropical Hydrology and 2nd Caribbean Islands Water Resources Congress, Proceedings of the International Symposium, May 5-8, 1985, San Juan, Puerto Rico. p 173-175.

Descriptors: *Instrumentation, *Hydrologic instruments, *Materials testing, Synthetics, Fiberglass, Economic aspects, Measuring instruments.

The programs of the U.S. Geological Survey require instrumentation for collecting and monitoring hydrologic data. The availability of space-age materials and implementation of state-of-the-art electronics is making possible recent developments of hydrologic instrumentation. Material developments include: Synthetic-fiber sounding and tag lines; fiberglass wading rod; polymer (plastic) sheaves, pulleys and sampler components; and polymer (plastic) bucket wheels for current meters. These materials are very cost effective and efficient. Electro-mechanical and electronic developments and applications include: adaptable data acquisition system; downhole sampler for hazardous substances; current-meter digitizer; hydraulic power-drive system for discharge measurements and water-quality sampling; non-contact water-level sensors; minimum data recorder; acoustic velocity meters, and automated current meter discharge-measurement system. (See also W87-06455) (Author's abstract)
W87-06491

REQUIREMENTS FOR ANALYTICAL PROCEDURES AND METHODOLOGIES IN THE OZONE TREATMENT OF WATERS AND WASTEWATERS,
Rice International Consulting Enterprises, Aston, MD.
For primary bibliographic entry see Field 5D.
W87-06494

METHODS OF DETERMINATION OF OZONE IN AIR AND IN WATER,
Societe Degremont, Rueil-Malmaison (France).
For primary bibliographic entry see Field 5D.
W87-06496

INSTRUMENTS FOR ANALYSIS OF OZONE IN AIR AND WATER,
Rice International Consulting Enterprises, Aston, MD.
R. G. Rice.

IN: Analytical Aspects of Ozone Treatment of Water and Wastewater, Lewis Publishers, Chelsea, Michigan. 1986. p 315-344, 18 fig, 4 tab, 25 ref.

Descriptors: *Water quality control, *Measuring instruments, *Ozone, Ultraviolet radiation, Chemiluminescence, Amperometry, Calorimetry, Potentiometry, Chemical analysis.

Different continuous measurement methods are used for ozone, depending upon its occurrence, generation, or its application. Atmospheric ozone or ozone present in the ambient air most often is measured by: (a) adsorption of UV radiation, (b) chemiluminescence (using ethylene), or (c) amperometry. Ozone produced in a corona discharge generator normally is measured by: (a) adsorption of UV radiation, or (b) calorimetry. Ozone dissolved in water (residual ozone) normally is measured by: (a) adsorption of UV radiation, (b) amperometry, or (c) potentiometry. Each of these techniques is presented, discussed and then summarized in a tabular format. (See also W87-06492) (Lantz-PTT)
W87-06513

EVALUATION OF LARVAL FISH SAMPLING GEARS FOR USE ON LARGE RIVERS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
T. R. Bosley, C. H. Pennington, M. E. Potter, and S. S. Knight.
Available from the National Technical Information Service, Springfield, VA. 22161. Technical Report E-86-9, July 1986. Final Report. 53 p, 13 fig, 1 tab, 61 ref.

Descriptors: *Fish, *Sampling, *Rivers, *Larvae, Plankton nets, Push sled, Diaphragm pump, Electroshocker, Basket implants, Fish management, Dikes, Revetments, Diurnal distribution, Mississippi River.

A study was conducted to evaluate the effectiveness of five different collecting gears in sampling larval fishes associated with dikes and revetments. The tests were conducted on the Lower Mississippi River at mile 508.8 and miles 447-448. The five collecting gears used were: plankton nets fished at discrete depths in the water column of a dike pool and the main channel; a push sled; a diaphragm pump; an electroshocker; and basket implants. These gears were used during the day and night to describe diel and temporal changes in the larval fish community in main channel, dike pool, dike, revetment, and sandbar habitats. The discrete depth net gear was effective in documenting the vertical, diel, and temporal distribution of ichthyoplankton drift in the main channel and dike pool habitats. Similarities and differences in ichthyoplankton abundance and diversity occurred between habitats. The most notable observation was the comparable abundance among like depth strata between habitats in May. In June, the surface stratum at each habitat contained a far greater abundance of larvae than the samples collected at lower depths. The push sled was effective for sampling shallow water in the vicinity of sandbars. Use of the sled revealed diel and temporal differences in the shallow-water ichthyoplankton. Night samples had a much greater abundance of larvae than day samples, especially in July. Carpsuckers, shad, and minnows were dominant in May, whereas minnows and carpsuckers comprised nearly all the larvae collected in July. The diaphragm pump, electroshocker, and implant baskets were used to sample ichthyoplankton associated with dike and revetment habitats. Of these gears, the diaphragm pump was the most effective. Samples collected along dikes and revetments contained a greater abundance and diversity of larvae than open-water samples. Based on the samples collected using the electroshocker, the presence of an electrical field did not improve catch efficiency. Of the three gears used to sample larval fish from dikes and revetments, the implant baskets were least effective. (Author's abstract)
W87-06521

MACROINVERTEBRATE GEAR EVALUATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
L. G. Sanders, C. R. Bingham, and D. C. Beckett.
Available from the National Technical Information Service, Springfield, VA. 22161. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS. Miscellaneous Paper E-86-3, August 1986. Final Report. 92 p, 14 fig, 2 tab, 14 ref.

Descriptors: *Macroinvertebrates, *Rivers, *Mississippi River, *Sampling, Rock basket implants, Rock samples, Electroshocker, Push sled, Diaphragm pump, Articulated concrete mattress implants, Benthos, Dikes, Performance evaluation.

Studies were conducted from May 1982 to October 1983 to evaluate the effectiveness of nine methods for collecting macroinvertebrates associated with dikes, revetments, and sandbar habitats. Data were collected on the Lower Mississippi River between river miles 440 and 448. Some gear types were used to test diel variations in the macroinvertebrate communities while others were used to obtain information on community structure and seasonal variation at dike, revetment, and sandbar habitats. All gears evaluated, with the exception of the electroshocker, were successful to some degree in sampling the macroinvertebrate fauna which colonized the dike and revetment structures in the areas investigated. The diaphragm pump is effective in sampling the macroinvertebrate fauna that colonized the dike structures and is effective in detecting diel and location (upstream versus downstream) differences in macroinvertebrate community composition. Both circular basket implants and rocks used to sample the dike and revetment structures are efficient techniques for sampling these habitats. Rock sampling can detect location differences (upstream versus downstream); however, it is a totally river stage-dependent technique whereas circular basket implants have the advantage of being retrieved regardless of river stage. The push sled is an effective technique for sampling shallow-water sandbar habitats; both diel and seasonal differences in macroinvertebrate drift can be detected. While the data collected using the revetment implants were not analyzed because all of the samplers were covered with sand and contained only a few organisms, this technique does show promise as it can serve two functions: sampling the revetment material, while at the same time sampling the substrate that is covered by the revetment. The articulated concrete mattress slabs and blocks and the modified Hess sampler were all effective in sampling the revetment structures. Removal of entire ACM slabs is very labor intensive, whereas sampling with the ACM blocks and the Hess sampler can be accomplished with relative ease. (Lantz-PTT)
W87-06525

BMRC AUSTRALIAN MONSOON EXPERIMENT: AMEX,
Bureau of Meteorology, Melbourne (Australia).
For primary bibliographic entry see Field 2B.
W87-06553

PORTABLE DEVICE FOR MEASURING SEDIMENT RESUSPENSION,
California Univ., Santa Barbara. Dept. of Mechanical and Environmental Engineering.
C.-H. Tsai, and W. Lick.
Journal of Great Lakes Research JGLRDE, Vol. 12, No. 4, p 314-321, 1986. 7 fig, 11 ref.

Descriptors: *Suspended sediments, *Limnology, *Resuspension, *Measuring instruments, *Entrainment, *Lake sediments, *Deposition, *Sediment transport, Sediment, Shear stress, Field tests, Water pollution control, On-site investigations, Sediment-water interfaces, Flumes, Performance evaluation.

A portable device for measuring sediment resuspension was developed. It consists of a cylindrical chamber within which a horizontal grid oscillates vertically. The sediments whose properties are to be determined are placed at the bottom of the chamber with water overlying them. The grid oscillates in the water and creates turbulence which penetrates down to the sediment-water interface and causes resuspension. The amount of material resuspended is proportional to the frequency of the grid oscillation. The device was calibrated by comparing the concentrations of the resuspended sediment at different grid frequencies with the concentrations in an annular flume where the bottom shear stress is known. The device can be used in the laboratory for rapid and reasonably accurate measurements of resuspension. The device was also tested on board ship and can be used in the field for rapid surveys of resuspension of undisturbed sediments. The device cannot be used in most cases to exactly determine the total amount of sediment that can be resuspended for a particular stress, although for cohesive sediments a reasonably accurate estimate should be achievable. Also, for long-term experiments laboratory flumes will be needed. (Airone-PTT)
W87-06583

DESIGN, CONSTRUCTION AND USE OF A MECHANICALLY RECORDING WATERTABLE METER,
Ministry of Agriculture, Fisheries and Food, Cambridge (England). Field Drainage Experimental Unit.
A. J. Talman.
Journal of Agricultural Engineering Research JAERA2, Vol. 33, No. 3, p 223-226, March 1986. 2 fig, 1 ref.

Descriptors: *Watertable meter, *Measuring instruments, *Design criteria, *Water table, Calibrations, Maintenance, Performance evaluation, Data collection, Dipwells, Engineering, Remote sensing, Experimental error, Piezometers.

An instrument is described which was developed and used by the Field Drainage Experimental Unit for over 15 years to record watertable data from experimental field sites. The instrument is fairly complex in design and requires specialist workshop equipment for construction and maintenance. The advantage that it has over dipwells and piezometers is that it records the fluctuating watertable data on a revolving chart attached to a clock. By making certain adjustments, the device can be used to record over either a 0.75 m or 1.5 m range with + or -20 mm and + or - 40 mm long-term accuracy respectively. Careful calibration and maintenance can reduce these errors to practically zero. Although, if this standard is to be maintained, the instrument needs to be check calibrated at least every 3 months. (Author's abstract)
W87-06593

ANALYSIS AND EVALUATION OF PUMPING TEST DATA,
International Inst. for Land Reclamation and Improvement, Wageningen (Netherlands).
G. P. Kruseman, and N. A. de Ridder.
International Institute for Land Reclamation and Improvement Bulletin 11, 1983. 200 p, 61 fig, 18 tab, 55 ref, 11 append.

Descriptors: *Pumping tests, *Mathematical models, *Aquifers, *Hydraulic properties, *Data interpretation, Pumps, Pump wells, Mathematical studies, Aquifer testing, Confined aquifers, Unconsolidated aquifers, Fluid mechanics, Unsteady flow, Steady flow, Piezometers, Performance evaluation.

This book is intended as a guidebook in analyzing and evaluating data from pumping tests to be used by those engaged in agricultural and groundwater engineering as well as students in these fields. It describes various methods of analyzing pumping test data scattered throughout many scientific journals sometimes written in different languages. Darcy's law, aquifer types, hydraulic properties, and types of flow equations are defined. Procedures for setting up a pumping test, the performance of a pumping test, and analysis of pumping test data are described. Methods of analyzing test data are given for the following conditions: steady-state flow in confined aquifers, steady-state flow in semi-confined aquifers, unsteady-state flow in semi-confined aquifers, unsteady-state flow in unconfined aquifers with delayed yield and in semi-

unconfined aquifers, steady-state flow in unconfined aquifers, unsteady-state flow in unconfined aquifers, aquifers limited by one or more boundaries, anisotropic aquifers, wedge-shaped aquifers, sloping aquifers, aquifers pumped at a variable discharge rate, partially penetrated aquifers, aquifers pumped by a large diameter well, and two-layered semi-confined aquifers. Approximation methods, analysis methods for free flowing wells, and corrections for external influences are also considered. (Geiger-PTT)
W87-06605

7C. Evaluation, Processing and Publication

AQUATIC ECOSYSTEM IDENTIFICATION USING THE GROUP METHOD OF DATA HANDLING,
Ecole Nationale Superieure d'Ingenieurs Electriciens de Grenoble, Saint-Martin d'Heres (France). Lab. d'Automatique.
For primary bibliographic entry see Field 2H.
W87-05928

COMPARISONS OF SEVERAL STRUCTURE-TOXICITY RELATIONSHIPS FOR CHLOROPHENOLS,
Texas Tech Univ., Lubbock. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W87-06040

COMPARISON OF TWO METHODS FOR DETERMINING COPPER PARTITIONING IN OXIDIZED SEDIMENTS,
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 5A.
W87-06061

TIME-SERIES APPROACH TO MODELLING STREAM ACIDITY,
Institute of Hydrology, Wallingford (England).
P. G. Whitehead, C. Neal, S. Seden-Perriton, N. Christophersen, and S. Langan.
Journal of Hydrology JHYDA7, Vol. 85, No. 3/4, p 281-303, July 1986. 15 fig, 33 ref.

Descriptors: *Model studies, *Acid rain, *Time series analysis, Streams, *Acid streams, *Acidity, Chemical properties, Flow, Hydrogen ion concentration, Aluminum, Sulfates, Magnesium, Calcium, Mathematical studies.

The techniques of time-series analysis were applied to field data from Norway, Scotland and Wales to model the response of stream acidity. Hourly, daily and weekly data for pH, flow, aluminium, sulfate, magnesium and calcium have been employed to identify model structures and estimate model parameters. The recursive time-series techniques were demonstrated to be particularly useful for identifying physical and chemical changes and providing simple, robust models of streamwater chemistry. The dominant processes were identified using the time-series techniques which provide a systematic method of analyzing hydrochemical data prior to the development of more complex physico-chemical models. (Author's abstract)
W87-06300

EQUIVALENCE OF THE SEQUENT PEAK ALGORITHM AND THE LINEAR PROGRAMMING METHOD FOR DETERMINING THE CAPACITY OF A SINGLE RESERVOIR,
West Virginia Univ., Morgantown. Dept. of Civil Engineering.
J. S. Gidley.
Journal of Hydrology JHYDA7, Vol. 89, No. 1/2, p 109-122, December, 1986. 1 tab, 8 ref, append.

Descriptors: *Algorithms, *Reservoir capacity, *Sequent peak algorithm, *Linear programming method, Spillage, Refill cycles, Reservoir evaporation.

With the standard assumptions of known inflows and requirements and final storage equal to or exceeding initial storage, the linear programming approach to determining the capacity of a single reservoir is equivalent to the sequent peak algorithm in that they must produce the same reservoir capacity. The sequence of storages and spills is not unique; the usual version of the sequent peak algorithm produces one sequence, whereas the linear programming approach may produce that sequence or some other. The subsequence of storages during critical drawdown periods must be the same, however. There exists a unique operating policy for a reservoir of minimum required capacity if one of two conditions is met: (1) the average inflow equals the average requirement; (2) all refill cycles are exactly one season long. An iterative method of accounting for evaporation losses in the sequent peak algorithm can be used. In practice it has been found to converge to the same reservoir as that found by linear programming. (Author's abstract)
W87-06382

COMPILATION OF HYDROLOGIC DATA FROM DRILLING THE SALADO AND CASTILE FORMATIONS NEAR THE WASTE ISOLATION PILOT PLANT (WIPP) SITE IN SOUTHEASTERN NEW MEXICO,
Sandia National Labs., Albuquerque, NM.
J. W. Mercer.
Available from the National Technical Information Service, Springfield, VA. 22161. Price codes: A03 in paper copy, and A01 in microfiche. Report No. SAND86-0954, January 1987. 39 p, 3 fig, 12 tab, 31 ref. DE-AC04-76DP00789.

Descriptors: *Data collections, *Data evaluation, *Salado Formation, *Castile Formation, *New Mexico, *Hydrologic data, *Path of pollutants, Waste treatment, Model studies, Brines, Wastewater treatment, Halites, Anhydrites.

This report compiles and evaluates data from tests performed on the Salado and Castile Formations during site characterization, exclusive of the 'brine reservoirs' in the Castile. It also examines if regional data are consistent with the experience of fluid encounters in the mined facility especially whether significant volumes of fluid might be involved in the Salado pressure buildups in the same way as small volumes were in the studies in the mined facility at the WIPP. Preliminary analyses of recently completed data from reentry and testing in WIPP-12 and testing of the Salado in DOE-2, are also included. Results of this study indicate that probably no overall interpretive model can be applied to the Salado and Castile Formations. That is, no definitive or unique explanation exists for the brine and/or gas occurrences or pressure buildups or their distribution in the borehole. Because of certain basic problems of well testing from the surface in low-permeability rock and because of the apparent low permeabilities, it is not recommended that continued hydrologic testing be conducted from the surface and penetrating the halites and anhydrites of concern at the WIPP. However, testing of the halite and marker beds at or near the WIPP mining horizon is practicable and should be carried out with the more sensitive instrumentation developed for that purpose. (Author's abstract)
W87-06452

HYDRAULIC-TEST INTERPRETATIONS FOR WELL DOE-2 AT THE WASTE ISOLATION PILOT PLANT (WIPP) SITE,
Sandia National Labs., Albuquerque, NM. Earth Sciences Div.
R. L. Beauheim.
Available from the National Technical Information Service, Springfield, VA. 22161. Price codes: A05 in paper copy, A01 in microfiche. Report No. SAND86-1364, November 1986. 89 p, 62 fig, 2 tab, 41 ref, append.

Descriptors: *Waste disposal, *Hydraulic properties, *Wells, *Path of pollutants, *Data evaluation, *Dewey Lake Red Beds, *Rustler Formation, *Salado Formation, *Bell Canyon Formation, Permeability, Fate of pollutants, Transmissivity, Hydraulic properties, Sandstone, Brines.

Eleven different zones were tested in Well DOE-2 in five phases of testing between 1984 and 1986. Testing techniques included a constant-head, borehole-infiltration test, drill-stem tests, slug tests, pressure-pulse tests, and multiwell pumping tests. Four of the zones tested - the lower Dewey Lake Red Beds, the Tamarisk Member of the Rustler Formation, the lower unnamed member of the Rustler Formation and Rustler/Salado contact, and the entire Salado Formation - had permeabilities too low to measure with the equipment and test techniques used. The other zones had permeabilities ranging over six orders of magnitude. No saturated strata were encountered above the Rustler Formation, although parts of the middle Dewey Lake Red Beds appear to have appreciable permeability. In the Rustler Formation, the Culebra Dolomite Member is the most permeable unit, having a transmissivity of approximately 90 sq ft/day. The Culebra behaves hydraulically as a double-porosity system, with the major permeability provided by fractures and the major storage provided by matrix porosity. The Culebra at DOE-2 is well connected hydraulically to the Culebra at Wells H-6b and WIPP-13 to the west, probably by interconnected fractures. Response times between these wells are very short (<1day/10,000 ft). In the Salado Formation, the interval including Marker Beds 138 and 139 and the WIPP facility horizon has an extremely low average permeability (<0.3 microd), and showed no evidence over about 2 days of testing of containing high-pressure sources of either brine or gas. In the Bell Canyon Formation, the Hyas sandstone was the most permeable unit tested, having an average permeability of about 2.4 md (0.55 ft/day). In freshwater terms, the observed Bell Canyon head is higher than the hydraulic head of the Culebra dolomite. If the Bell Canyon and Culebra were connected by an open borehole, however, salt dissolution in the Salado section would increase the specific gravity of the Bell Canyon fluid so that, at the elevation of the Culebra, the Culebra head would be higher than that of the Bell Canyon. In this event, the flow direction would be downward from the Culebra into the Bell Canyon. (Lantz-PTT)
W87-06453

DETECTING CHANGES IN GROUND WATER QUALITY AT REGULATED FACILITIES,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
For primary bibliographic entry see Field 5G.
W87-06573

LAKE HURON ROTIFER AND CRUSTACEAN ZOOPLANKTON, APRIL-JULY, 1980,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 2H.
W87-06580

DENSITY AND DISTRIBUTION OF LARVAL FISHES IN PENTWATER MARSH, A COASTAL WETLAND ON LAKE MICHIGAN,
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
For primary bibliographic entry see Field 2H.
W87-06586

ANALYSIS AND EVALUATION OF PUMPING TEST DATA,
International Inst. for Land Reclamation and Improvement, Wageningen (Netherlands).
For primary bibliographic entry see Field 7B.
W87-06605

NBS/NRC STEAM TABLES: THERMODYNAMIC AND TRANSPORT PROPERTIES AND COMPUTER PROGRAMS FOR VAPOR AND LIQUID STATES OF WATER IN SI UNITS,
National Bureau of Standards, Washington, DC.
For primary bibliographic entry see Field 1A.
W87-06610

8. ENGINEERING WORKS

8A. Structures

EARTHQUAKE ANALYSIS OF ARCH DAMS INCLUDING DAM-WATER INTERACTION, RESERVOIR BOUNDARY ABSORPTION AND FOUNDATION FLEXIBILITY,
California Univ., Davis. Dept. of Civil Engineering.
K.-L. Fok, and A. K. Chopra.
Earthquake Engineering and Structural Dynamics IJEEBG, Vol. 14, No. 2, p 155-184, March-April 1986. 19 fig, 2 tab, 18 ref. National Science Foundation Grants CEE-8120308 and CEE-8401439.

Descriptors: *Arch dams, *Earthquake engineering, *Dam design, *Dam stability, *Dam foundations, *Cost analysis, *Dams, *Computer programs, Flexibility, Engineering, *Computers, Mathematical equations, Mathematical studies, Dam-water relationships, Reservoir design, Reservoir boundary absorption, Reservoirs, Foundation flexibility, Foundation rocks, Fourier analysis.

The available substructure method and computer program for the steady-state, harmonic response analysis of arch dams, including the hydrodynamic effects, are extended to consider flexibility of foundation rock and to include Fourier synthesis of harmonic responses to obtain the earthquake response of arch dams. By efficient evaluation of hydrodynamic terms, interpolation of frequency response functions and more efficient computer programming, the computational costs for analyzing arch dams were reduced by an order of magnitude relative to the available procedure. (Author's abstract)
W87-06072

STUDY OF THE EARTHQUAKE RESPONSE OF PINE FLAT DAM,
California Inst. of Tech., Pasadena. Dept. of Civil Engineering.
J. F. Hall.
Earthquake Engineering and Structural Dynamics IJEEBG, Vol. 14, No. 2, p 281-295, March-April 1986. 11 fig, 1 tab, 13 ref. NSF Grant CEE-8317257.

Descriptors: *Concrete dams, *Gravity dams, *Dam stability, *Dams, *Earthquakes, *Model studies, *Pine flat dam, Dam design, Dam foundations, Mathematical studies, Mathematical models, Elastic properties.

The earthquake response of Pine Flat Dam, a concrete gravity dam, is examined by a study of time history responses computed for a large set of earthquake ground acceleration records whose time axes were systematically varied. Linear elastic behavior is assumed. Topics considered include an investigation of the importance of water, water compressibility and the vertical component of ground motion; an evaluation of the accuracy of the lumped, added mass representation of the water; and a determination of the intensity of earthquake required to initiate non-linear behavior in both the dam and water. (Author's abstract)
W87-06073

UTILIZATION OF FLEXIBLE MEMBRANE TO IMPOUND RUNOFF WATER IN RECEIVING COAST FOR WATER CONSERVATION AND QUALITY CONTROL,
Hawaii Univ. at Manoa, Honolulu. Dept. of Civil Engineering.
Y. S. Fok, and E. T. Murabayashi.
IN: Collected Reprints, Volume V: 1978-1981, June 1984. Water Resources Research Center, Honolulu, Hawaii. p 222-227, 7 ref.

Descriptors: *Water storage, *Water supply development, *Hydraulic models, *Design criteria, *Impervious membranes, Membranes, Evaluation, Water supply, Water resources development, Model studies, Planning, Controlled storage, Reservoirs, Storm water, Reservoir storage.

One of the primary factors precluding the use of storm water and other surplus water is the economic cost of storing until it can be used. Dams and reservoirs resulting in inundated lands are generally too expensive for storing low-quality water for irrigation and other uses. The possibility and feasibility of using an impermeable, flexible membrane for storing water in another body of water, such as the ocean, is examined. Two dam projects have successfully stored 30 billion gallons of water in marine bays in Hong Kong. The use of impermeable membranes to impound water offers more flexibility for land use than permanent dams or reservoirs. Success in the use of flexible impermeable membranes has been demonstrated by the U.S. Navy. Model studies are required to develop design criteria for a flexible membrane storage project. At least fourteen design variables have been identified in model formulation for water impoundment in coastal areas. Flexible membranes can be fabricated in compartments to store water with different qualities. (See also W87-06103) (Geiger-PTT)
W87-06116

8B. Hydraulics

PROPAGATION OF HYDRAULIC DISTURBANCES AND FLOW RATE RECONSTRUCTION IN ACTIVATED SLUDGE PLANTS,
Lund Univ. (Sweden). Dept. of Automatic Control.
For primary bibliographic entry see Field 5D.
W87-05930

REDUCTION OF PRESSURE SURGES BY MINIMAX OPTIMIZATION,
Arizona Univ., Tucson. Dept. of Systems and Industrial Engineering.
S. Sen, and D. N. Contractor.
Applied Mathematical Modelling AMMODL, Vol. 10, No. 4, p 271-277, August 1986. 2 fig, 3 tab, 20 ref.

Descriptors: *Pipelines, *Pipes, *Pipe flow, *Surges, *Optimization, *Linear programming.

Pressure surges in pipelines result from rapid changes in valve settings, starting and stopping of pumps and turbines, changes in load on hydroelectric generators, rapid chemical reactions and thermal changes, and many other causes. Pressure surges can be controlled in many ways so as to result in lower maximum pressures in the pipeline. These methods include reduction of wave velocity, the use of air chambers, surge tanks, relief valves and surge suppressors - all capital intensive ways of controlling pressure surges. Valve stroking is another effective way to control fluid transients by operating the valve in a prescribed manner, so that the magnitude of transient pressures is controlled. This paper deals with the control of pressure surges in a simple system consisting of a single horizontal pipe. The methodology, however, is easily extended to more complex systems and is quite easily implemented. The control problem is formulated as a nonlinear minimax optimization problem. Due to the large-scale nature of such problems, a successive linear programming (LP) method is adopted. The convergence of the method is accelerated by a conjugate gradient type search. Computational results are also provided. (Authors' abstract)
W87-05979

DRAG OVER CYLINDRICAL OBSTACLES IMMERSED IN THE FLOW OF A CONCENTRATED SUSPENSION OF SOLID PARTICLES IN WATER (TRAINEE SUR DES OBSTACLES CYLINDRIQUES IMMERGES DANS L'ECOULEMENT D'UNE SUSPENSION CONCENTREE DE PARTICULES SOLIDES EN EAU),
Institut de Mecanique de Grenoble, Saint-Martin d'Heres (France).
C. Pfeiff, and E. Hopfinger.
La Houille Blanche, No. 4/5, p 343-348, 1986. 6 fig, 10 ref.

Descriptors: *Hydraulics, *Hydrodynamics, *Drag, *Fluid mechanics, *Suspended sediments, *Suspended solids, Rheology, Bed load, Rivers, Stress, Sediments.

Underconsolidated sediments are often found at the outlets of great rivers having a high percentage of bed loads. Their motion engendered through various causes (swell, seisms) poses a risk for foundations of off-shore platforms situated in these zones. Results presented on the drag of a cylinder immersed in the suspension of solid particles in water (volume concentration < or = 65%) enable the stresses on the foundations to be evaluated. An experimental study on the rheological properties of suspensions used shows the effect of various parameters (deformation ratio, volume concentration nature of suspension) on drag. (Author's abstract)
W87-06006

DETERMINATION OF DRAG COEFFICIENTS IN TURBULENT FLOW OF WATER AT SUPERCRITICAL PRESSURES IN SMOOTH CHANNELS,
Kiev Polytechnic Inst. (USSR).
V. G. Razumovskiy, A. P. Ornatskiy, Y. M. Mayevskiy, and N. V. Igol'nikova.
Fluid Mechanics-Soviet Research FMSVAM, Vol. 14, No. 5, p 1-6, September-October 1985. 2 fig, 5 ref. Translated from Promyshlennaya Teplotekhnika, Vol. 7, No. 5, p 24-28, 1985.

Descriptors: *Drag, *Turbulent flow, *Channels, *Flow characteristics, *Fluid mechanics, *Hydraulics, *Supercritical pressure, Flow, Enthalpy, Thermodynamics, *Hydrodynamics, Friction, Temperature, Physical properties, Mathematical analysis.

The results of experimental determination of local friction drag coefficients in turbulent flow of water at supercritical pressure in a 6.3 mm diameter tube at enthalpies between 1400 and 2200 kJ/kg and heating rates of 0.25 to 1.5 kJ/kg are presented. The accuracy of the traditional one-dimensional method of determination of hydraulic parameters is assessed, and it is shown that the error under the conditions of the present study does not exceed 35%. The friction factor is proven to be virtually independent of the temperature of the flow. The experimental data are compared with available computational formulas and an expression is suggested for determining the drag coefficient, which is valid when the physical properties of water at supercritical temperatures are strongly temperature-dependent. (Author's abstract)
W87-06008

HETEROGENEOUS MECHANISM OF VAPORIZATION IN A FLOW OF STRONGLY SUPERHEATED WATER,
K. I. Soplenkov, and V. N. Blinkov.
Fluid Mechanics-Soviet Research FMSVAM, Vol. 14, No. 3, p 115-120, May-June 1985. 2 fig, 8 ref. Translated from Nestatsionarnye Techeniya Mnogofaznykh Sistem s Fiziko-Khimicheskimi Prevrashcheniyami, p 105-109, 1983.

Descriptors: *Nucleation, *Hydrodynamics, *Vaporization, *Superheated water, *Nozzles, *Flash evaporation, *Flow, Model studies, Evaporation, Fluid mechanics, Bubbles, Flow characteristics, Mathematical analysis.

The hypothesis of heterogeneous nucleation within a fluid is used to derive a relationship needed for closing the set of equations required for describing the nonequilibrium discharge of flashing water from pipes and nozzles. Over the range of Gibbs numbers under study, the number of viable nucleation sites ranges from 5 x 10 to the 11th to 5 x 10 to the 13th power per cu m. If the initial pressure of saturated water is raised to 160 bar, the Gibbs numbers in the flow are 20 to 30, suggesting the dominance of homogeneous (spontaneous) nucleation. Thus, the assumption of the existence of heterogeneous nucleation within the liquid leads to a relationship for N = N(G) (where G = Gibbs number corresponding to the superheated state of the liquid and N = the number of viable nucleation sites needed for the closure of the set of equations describing nonequilibrium steady-state

discharge of flashing water over the range of initial parameters studied). (Author's abstract)
W87-06014

EARTHQUAKE ANALYSIS OF ARCH DAMS INCLUDING DAM-WATER INTERACTION, RESERVOIR BOUNDARY ABSORPTION AND FOUNDATION FLEXIBILITY,
California Univ., Davis. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8A.
W87-06072

STUDY OF THE EARTHQUAKE RESPONSE OF PINE FLAT DAM,
California Inst. of Tech., Pasadena. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8A.
W87-06073

REPAIR OF WATERSTOP FAILURES: CASE HISTORIES,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Structures Lab.
For primary bibliographic entry see Field 8G.
W87-06294

TRIANGULAR SIDE WEIRS,
National Inst. of Hydrology, Roorkee (India).
C. P. Kumar, and S. K. Pathak.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 113, No. 1, p 98-105, February 1987. 5 fig, 1 tab, 10 ref.

Descriptors: *Weirs, *Mathematical equations, *Hydraulic structures, Channel flow, Hydraulics, Flow characteristics, Flow discharge, Froude number, Channels, Mathematical studies, Least squares method.

Discharge characteristics of sharp and broad-crested triangular side weirs which are located at the upstream end of a 90 degree branch channel were experimentally investigated. The experiments were restricted to subcritical flow in the main channel and free flow into the branch channel. Flow equations based on the laboratory data were presented. Relations between discharge coefficients and main channel Froude number for different apex angles were established. (Wood-PTT)
W87-06416

EFFECTS OF SEDIMENT-LADEN FLOW ON CHANNEL BED CLOGGING,
Montana State Univ., Bozeman. Dept. of Civil Engineering and Engineering Mechanics.
For primary bibliographic entry see Field 2J.
W87-06417

8C. Hydraulic Machinery

MECHANICAL-HYDRAULIC DUAL-ACTING CONTROLLER FOR CANAL LEVEL OR DISCHARGE RATE,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
A. J. Clemmens, and J. A. Replogle.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 113, No. 1, p 69-85, February 1987. 10 fig, 13 ref.

Descriptors: *Hydraulic machinery, *Hydraulic equipment, *Canals, *Flow regulators, *Water level, *Discharge rates, *Flow rates, Flow control, Flow, Surface flow, Weirs, Flumes, Field tests, Gates, Hydraulic gates, Radial gates, Comparison studies, Performance evaluation.

A control device was developed for canal structures, which can be used to control upstream water levels, downstream water level, or offtake canal discharges. The system uses no electrical power or electronics. It is powered by the available drop in water level across the structure. It can control water levels to within a very narrow band (plus or minus 3 mm (0.01 ft) for the systems tested), which is not feasible with electrically controlled motorized gates. Since this level of water surface control is often necessary for accurate flow rate control when weirs and flumes are used, this device, called dual-acting controlled-leak, or DACL, is particularly suited to control of canal flow rates. The DACL system was studied in a hydraulics laboratory to determine the relevant factors affecting control. A field test was conducted on a radial gate (1.9 m (6.2 ft) radius) to study the system's reliability in actual field operation. (Author's abstract)
W87-06414

8D. Soil Mechanics

URBAN USE OF PEAT SOILS,
For primary bibliographic entry see Field 4A.
W87-06631

MAIN PROPERTIES OF HORTICULTURAL PEAT,
Peat Research Inst., Helsinki (Finland).
For primary bibliographic entry see Field 2G.
W87-06635

8F. Concrete

VARIATIONS IN CEMENTITIOUS MEDIA,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Structures Lab.
R. E. Reinhold, by R. E. Richter, A. D. Buck, K. Mather, and B. Mather.
Available from the National Technical Information Service, Springfield, Virginia 22161, as ADA 171753, A12 in paper copy, A01 in microfiche. Army Corps of Engineer Technical Report SL-86-10, May 1986. Final Report. 269 p, 2 ref, 6 append.

Descriptors: *Cements, *Portland cements, *Materials testing, Physical properties, Chemical properties, Petrography, Fly ash, Slag, Pozzolans.

A total of 59 cements, 12 fly ashes, 19 silica fumes from 16 sources, 3 natural pozzolans, and 1 ground granulated iron blast-furnace slag, and laboratory combinations of these materials were studied by a combination of physical, chemical, and petrographic methods. Creep data were obtained for 17 pastes made using some of these materials. Since so many different materials and types of data are presented in this report, the data are presented in tabular form, with some discussions included in the appendices. The report concludes that the use of energy conservation measures such as precalciners or preheaters in producing portland-cement clinker did not have any significant effect on physical or chemical properties or constitution of the cement as revealed by petrographic examination compared with samples not produced with such equipment. (Lantz-PTT)
W87-06199

COMPARISON OF CEMENT GROUTS MIXED BY HIGH-SPEED AND LOW-SPEED GROUT MIXERS,
Water and Power Resources Service, Denver, CO. Engineering and Research Center.
W. G. Smoak, and S. Carter.
Available from the National Technical Information Service, Springfield, VA. 22161. Bureau of Reclamation Report No. REC-ERC-86-5, May 1986. 11 p, 10 fig, 8 tab.

Descriptors: *Cement, *Materials testing, *Grout, Portland cement, Physical properties.

The Portland Cement Grout Research Program is part of the Bureau of Reclamation's PRESS (Program Related Engineering and Scientific Studies) allocation, No. DF-12. The purpose of the program is to gain increased knowledge of portland cement grouting materials and systems used in sealing and stabilizing dam foundations. The main objective of this phase of the Portland Cement Grout Research Program was to evaluate the physical properties of grouts produced by two different mixers, the high-speed colloidal and the paddle mixers. This report discusses the physical properties of grout prepared in each mixer, test parameters, test procedures, test results, conclusions, and recommendations for future research. All mixes in the testing program produced grouts exhibiting good hydration and good physical properties. Grouts prepared with the high-speed mixer exhibited less bleed water, more retentivity, and less shrinkage. They also showed up to 20% faster flow through a standard flow cone. The compressive strength test results of grout samples indicated no significant strength differences caused by mixer type. (Lantz-PTT)
W87-06449

8G. Materials

REPAIR OF WATERSTOP FAILURES: CASE HISTORIES,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Structures Lab.
J. E. McDonald.
Available from the National Technical Information Service, Springfield, VA. 22161. Army Corps of Engineers, Technical Report REMR-CS-4, November 1986. Final Report. 240 p, 163 fig, 2 tab, 12 ref.

Descriptors: *Dam failure, *Dam construction, *Materials testing, *Leakage, *Case studies, *Waterstops, Hydraulic structures, Monolith joints, Concrete.

Nearly every concrete structure has joints that must be sealed to ensure its integrity and serviceability. This is particularly true for monolith joints in hydraulic structures such as concrete dams and navigation locks. Embedded waterstops are generally used to prevent water passage through the monolith joints of such structures. A waterstop failure can result in various problems ranging from minor leakage with cosmetic concern to significant hydraulic forces and structural overloading which could threaten the stability of a structure. The primary objective of this study was to identify materials and techniques which have been used in repair of waterstop failures. Also, based on review and evaluation of current practices, a secondary objective was to identify those areas where research is needed to supplement existing technology. Leakage through monolith joints ranged from minor flows to more than 600 gal/min. In general, leakage was the result of waterstop defects including (a) excessive movement of the joint which ruptures the waterstop, (b) honeycomb areas adjacent to the waterstop resulting from poorly consolidated concrete, (c) contamination of the waterstop surface which prevents bond to the concrete, (d) puncture of the waterstop or complete omission during construction, and (e) breaks in the waterstop due to poor or no splices. More than 80 different materials and techniques have been used, individually and in various combinations, to repair the waterstop failures reported here. Some appear to have been successful, while many have failed. Because of a lack of appropriate test methods and equipment, most materials have been used in prototype repairs with limited or no laboratory evaluation of their effectiveness in the particular application. A definite need exists for development of testing procedures and equipment to allow systematic laboratory evaluation of waterstop repair techniques prior to application in prototype structures. (Lantz-PTT)
W87-06294

CORROSION OF CORRUGATED GALVANIZED STEEL IN CONSERVATION STRUCTURES,
Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.
T. J. Moore, C. T. Hallmark, G. Chervenka, D. Henry, and D. Garner.
Journal of Soil and Water Conservation JWSCA3, Vol. 41, No. 2, p 128-131, March-April 1986. 3 fig, 2 tab, 15 ref.

Descriptors: *Corrosion rate, *Spillways, *Evaporation, *Reservoirs, *Galvanized metals, Electrical conductivity, Texas, Calcium carbonate, Precipita-

tion, Reservoir design, Construction materials, Design criteria.

Corrosion and subsequent failure of metal spillways in water retention structures in Brazos County, Texas, were studied to assess corrosion rates of corrugated, galvanized metal in contact with evaporating water. Electrical conductivity, the most commonly used indicator of corrosivity, was a poor index of corrosion in these systems. Concentration of individual ions, particularly chloride, and the amount of CaCO3 precipitated upon evaporation of water in contact with the metal can be used to assess metal corrosivity. Application of the results and design changes in construction of corrugated, galvanized structures are discussed. (Author's abstract)
W87-06402

8I. Fisheries Engineering

STREAM CHANNEL MODIFICATIONS AND RECLAMATION STRUCTURES TO ENHANCE FISH HABITAT,
Wyoming Univ., Laramie. Water Resources Research Inst.
For primary bibliographic entry see Field 6G.
W87-06440

DYNAMICS OF REPRODUCTION BY HATCHERY LAKE TROUT ON A MAN-MADE SPAWNING REEF,
Michigan Dept. of Natural Resources, Marquette. Marquette Fisheries Station.
J. W. Peck.
Journal of Great Lakes Research JGLRDE, Vol. 12, No. 4, p 293-303, 1986. 2 fig, 5 tab, 26 ref.

Descriptors: *Trout, *Hatching, *Artificial reefs, *Reproduction, *Lake Superior, *Population dynamics, *Spawning, *Limnology, Aquatic habitat, Ecological effects, Fish behavior.

Reproduction by hatchery lake trout, critical for rehabilitation of lake trout stocks in the Great Lakes, had not been previously described and measured. Reproduction by hatchery lake trout on a man-made spawning reef in Presque Isle Harbor, Lake Superior, in 1977-80 was qualitatively and quantitatively described using gill nets, egg traps and fry traps. Scuba divers measured physical parameters of the reef. Lake trout spawned during a 15- to 28-day period between 12 October and 14 November mainly during 1800-2000 hours. The Petersen single census was a better method of estimating adults than either multiple-census or fecundity-egg deposition methods. The Petersen estimate of adults was nearly 4,000 males and 1,900 females in 1979. Egg deposition and swim-up fry production ranged from 122 to 518/sq m and 20 to 46/sq m, respectively. Substrate on the man-made reef was a 27-to 42-cm thick layer of granite and limestone cobbles 6 to 20 cm in diameter. Spawning behavior and quantitative aspects of reproduction by hatchery lake trout were similar to that previously reported for native lake trout in the Great Lakes and elsewhere. Man-made reefs may be a valuable lake trout management tool. (Airone-PTT)
W87-06581

MOVEMENTS OF RAINBOW STEELHEAD TROUT (SALMO GAIRDNERI) IN LAKE ONTARIO AND A HYPOTHESIS FOR THE INFLUENCE OF SPRING THERMAL STRUCTURE,
State Univ. of New York Coll. at Brockport. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2H.
W87-06582

STREAM BED CONFIGURATION AND STABILITY FOLLOWING GABION WEIR PLACEMENT TO ENHANCE SALMONID PRODUCTION IN A LOGGED WATERSHED SUBJECT TO DEBRIS TORRENTS,
Poulin (V.A.) and Associates Ltd., Vancouver (British Columbia).
H. D. Klassen, and T. G. Northcote.
Canadian Journal of Forest Research CJFRAR, Vol. 16, No. 2, p 197-203, April 1986. 4 fig, 2 tab, 28 ref.

Descriptors: *Stream bed configuration, *Stream bed stability, *Gabion weirs, *Salmonid production, *Fisheries engineering, *Debris torrents, *Sachs Creek, Queen Charlotte Islands, Fish, Spawning habitats, Spawning Salmon, Trout, Scour, Channels, Reproduction, Growth.

Tandem V-shaped gabion weirs for improving spawning habitat for salmon were installed to replace large organic debris at three sites below the terminus of a debris torrent in Sachs Creek, Queen Charlotte Islands. Stream conditions were compared between gabion and nearby control sites. The stability of added and entrapped gravel at all gabion sites was poor over the first winter and excessive scour threatened the integrity of the upstream steeper (3%) slope gabion site. However, the two gabion sites at lower (1%) slope successfully stabilized spawning gravel in the second year after installation, probably through a reduction in the local slope gradient and self-armouring of the high flow channels. Higher summer densities of juvenile coho slamon and steelhead trout were recorded at the gabion sites compared with the control sites. Underyearling coho fry were also significantly larger at gabion sites than at control sites. Improved rearing habitat was created for coho juveniles by the gabions, a result of increased pool area and cover. (Author's abstract)
W87-06602

9. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

ROLE OF UNIVERSITIES IN SOLVING FUTURE WATER PROBLEMS,
Texas Univ. System, Austin. Board of Regents.
For primary bibliographic entry see Field 6B.
W87-06161

9C. Research Facilities

WATER RESOURCES IN TEXAS: THE NEED FOR A WATER RESEARCH AGENDA.
Texas Univ. at Austin. Center for Research in Water Resources.
For primary bibliographic entry see Field 6B.
W87-06144

RESEARCH - A VITAL LINK IN EFFECTIVE WATER MANAGEMENT,
Florida Univ., Gainesville. Dept. of Engineering Sciences.
For primary bibliographic entry see Field 6B.
W87-06146

9D. Grants, Contracts, and Research Act Allotments

FISCAL YEAR 1985 PROGRAM REPORT. VIRGINIA WATER RESOURCES RESEARCH CENTER.
Virginia Water Resources Research Center, Blacksburg.
Aailable from the National Technical Information Service, Springfield, VA 22161 as PB87 112421/AS, Price codes: A03 in paper copy, A01 in microfiche. Contract No. 14-08-0001-G1049, Project No. USGS G1049-01. Program Report G 1049, August 1986. 21 p, 3 tab.

Descriptors: *Water resources institutes, *Research, *Information transfer, *Training, *Education, *Virginia, Groundwater management, Groundwater pollution, Sludge utilization, Heavy metals, Nonpoint source pollution, Water quality, Management.

The Virginia Water Resources Research Center's 1985 research, information transfer, and education programs focus on the effects of land use practices on water resources. Federal monies sponsored projects on land application of sewage sludge and groundwater protection strategies. State funding supported work on (1) the long-term effectiveness of vegetated buffer strips; (2) effects of fertilizer application techniques on phosphorus losses in no-till cultivation systems; (3) the effectiveness of BMPs for stormwater management; (4) evaluating local governmental land use management programs; (5) evaluating potential groundwater contamination from contaminated soils; (6) investigating the biodegradation potential of groundwater contaminants; (7) beginning a baseline bacteriology of Virginia's groundwater; and (8) assessing the performance of three types of detergent in water of varying hardness. These projects provided training for 26 individuals (2 with federal funds and 24 with state funds). The Center also trained two interns: one in communications studies and one in geography. Information transfer projects included (1) publication of four bulletins, one special report, 12 issues of the monthly newsletter; (2) initiation of a new publication series emphasizing the human aspects of water resource problems; and (3) cosponsorship of two conferences. Two new publications, two computer programs, and a five-minutes slide-tape program showing how groundwater creates caves were developed for the education program. (Hrezo-VPI)
W87-06078

SOUTH CAROLINA FISCAL YEAR 1985 PROGRAM REPORT. SOUTH CAROLINA WATER RESOURCES RESEARCH INSTITUTE.
Clemson Univ., SC. Water Resources Research Inst.
Available from the National Technical Information Service, Springfield, VA 22161 as PB87 112405/AS, Price codes: A03 in paper copy, A01 in microfiche. Contract No. 14-08-0001-G1043, Project No. USGS G1043-01. Program Report G1043, June 1986. 36 p.

Descriptors: *Water Resources Institutes, *South Carolina, *Research, *Training, *Education, Manganese, Oxidation, Kinetics, Oxygenation, Defloridation, Activated alumina, Groundwater, Sediment transport, Open channels, Shallow water, Catchment, Recharge, Discharge, Management, Contaminants, Radioactivity, Model testing, Cesium radioisotopes, Tritium, Watersheds.

Discussion is presented concerning the high priority water quality and other problems existing in South Carolina. Research projects funded by the Water Resources Research Institute to assist in the solution of these problems include: (1) A study of the occurrence of toxic manganese in the discharges from the new Richard Russell Dam located on the upper Savannah River in SC and GA to determine if proposed methods of handling this problem will be adequate. (2) An investigation of various methods for removing flourides from Black Creek aquifer waters. (3) A project on the study of sediment transport on steep slopes in which the relationships between the ground slope, soil size and water discharge on the sediment transport capacity were determined. (4) A project to better understand the recharge-discharge area, the Piezometric Surface and the water chemistry characteristics of the tertiary Limestone/Land Aquifer System of SC. (5) A project is being continued for a second year that will aid state and regional agencies in assessing the long term effects of current and surface runoff on aquatic ecosystems. (6) A completed project included a predictive model that can be relied upon to yield accurate calculations of radionuclide concentrations under varying conditions. (Zielinski-Clemson)
W87-06080

FISCAL YEAR 1985 PROGRAM REPORT. UTAH CENTER FOR WATER RESOURCES RESEARCH.
Utah Center for Water Resources Research, Logan.
Available from the National Technical Information

Service, Springfield, VA 22161, as PB87 112397/AS, Price codes: A04 in paper copy, A01 in microfiche. Program Report G-1047-01, August 1986. 25 p, 1 fig, 2 tab, 1 ref. Contract No. 14-08-0001-G1047, Project No. USGS G1047-01.

Descriptors: *Research, *Information transfer, *Training, *Utah, Desert, Hydrologic balance, Bowen-ratio, Arid lands, Hydrometeorology, Atmospheric stability, Evaporation, Data collection, Energy balance, Groundwater, Water balance, Alluvial fan, Evapotranspiration, Salinity, Recharge, Health, Water resources pollution, Heavy metals, Groundwater pollution, Leaching, Waste treatment, Land disposal, Soil amendment.

Within the $2 million research program underway in 10 major program areas at the Utah Water Research Laboratory, two topics have been selected for development with USGS funds through the Utah Center for Water Resources Research. One examines and quantifies fundamental hydrologic and climatologic processes in closed desert basins. The second examines fundamental chemical and biological processes occuring when hazardous wastes enter the environment with the immediate practical application of becoming better able to protect groundwater against pollution by organic chemicals (largely petroleum-related in Utah) and toxic heavy metals. During fiscal year 1985, UCWRR supported two projects on each topic. The first desert hydrology study is employing a transect of precipitation gages and evaporation pans across the Pilot Valley to collect data for defining precipitation patterns and computing energy budgets to permit better estimates of net evaporation achievable for analysis of lake level control during wet periods. A system which can measure evaporation using the Bowen-ratio technique was constructed and tested for quantifying the water budget. In a second study a 2-dimensional mathematical model of flow toward a desert playa is being developed. The groundwater protection study area also had two projects. The third UCWRR project is collecting well water near underground storage tanks, characterizing the discovered petroleum products, and quantifying exposure to toxic effects (both immunologic and neurotoxic). Finally, soil-metal interactions were examined in the laboratory to determine how the metals in mining and other industrial wastes can be immobilized in land disposal and land spill sites. Soil amendments that increase leachate pH and promote sorption by providing carbonate surfaces were most effective. (James-Ut. St. U)
W87-06081

FISCAL YEAR 1985 PROGRAM REPORT. NEVADA WATER RESOURCES CENTER.
Nevada Univ. System, Reno. Water Resources Center.
Available from the National Technical Information Service, Springfield VA 22161, as PB87 112371/AS, Price codes: A03 in paper copy, A01 in microfiche. Program Report G1030-01, August 1986. 28 p. Contract No. 14-08-0001-G1030, Project No. USGS G1030-01.

Descriptors: *Research, *Information transfer, *Training, *Nevada, *Water Resources Institutes, Conjunctive use, Salinity, Photosynthesis, Water use efficiency, Flooded plains, Mass wasting, Remote sensing, Hazards, Lake shores, Solubility, Irrigation, Scheduling, Economic aspects, Water use, Root distribution.

Nevada's arid climate limits the available water supply, yet attracts increasing numbers of people. Over the past two decades, Nevada has had one of the highest growth rates in the nation. This increase in population has placed demands on existing water supplies as well as waste treatment facilities. Two projects addressed water availability: one was developed to optimize the usage of surface and ground water in the Truckee Meadows area; and the second investigated the water and energy savings that can occur using an irrigation scheduling program which estimates soil moisture deficiency. Because agriculture is being forced to consider the possibility of utilizing poorer quality waters, one research effort studied the influence of varying leaching fractions, water quality and soil type on root distribution and fractional water uptake. Salinity problems were addressed in two projects; one investigated the salinity effects on the photosynthetic CO2 fixation, while the second evaluated the effects of salt bearing shoreline formations on the salt load of Lake Mead and the Lower Colorado River Basin. Also, due to its arid nature, Nevada is susceptible to flash floods and mass wasting during short-duration high-intensity rain events. One research project explored the use of remote sensing techniques for identification of water related hazard zones, which has direct application to such problems. A total of nine undergraduate and eight graduate level students participated in the 1985 program. (Cosens-Desert Res. Inst., NV U.)
W87-06082

FISCAL YEAR 1985 PROGRAM REPORT. DELAWARE WATER RESOURCES CENTER, Delaware Univ., Newark. Water Resources Center.
R. D. Varrin.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87 112363/AS, Price codes: A03 in paper copy, A01 in microfiche. Program Report G1008-01, August 1986, 25 p. Contract No. 14-08-0001-G-1008. Project No. USGS G1008-01.

Descriptors: *Research, *Information transfer, *Training, *Delaware, *Water Resources Institutes, Groundwater recharge, Hydrology, Environmental impacts, Geomorphology, Contamination, Groundwater, Adsorption, Toxic chemicals, Activated carbon, Heavy metals, Organic compounds, Bound water, Sludge drying, Nitrogen, Corn, Irrigation, Computer programs, Management planning, Storm water, Technology transfer.

The Fiscal Year 1985 Delaware Water Research Institute Program was responsive to the water problems of Delaware and the surrounding region. Groundwater contamination management, a most critical research need, was the focus of three projects. Project 02 examined the effect of landfill management on leaching volume and discovered that in humid regions, landfill sites that have no impervious covering will experience leaching two to three years after active use of the site has been discontinued. A continuation project, 04, tested the use of an activated carbon process for removing toxic chemicals from contaminated ground water and found the process a viable method for cleanup. And project 07, also a continuation, produced more data on the influence of nitrogen management and irrigation practices on groundwater quality. One project, 03, dealt with nonpoint source pollution in a study that monitored a meander bend of the Brandywine River to develop a quantitative model of riverbank erosion. And project 05, an investigation of point source pollution, consisted of three experiments to study sludge flocculation effects on bound water. The information transfer component of the 1985 program consisted of two projects. The first, 22, produced three issues of the Delaware Water Resources Center News; and the second, 23, resulted in a computer software package to be used in the selection of techniques to mitigate the effects of stormwater runoff for a given site. (Benson-U DE)
W87-06083

FISCAL YEAR 1985 INSTITUTE PROGRAM REPORT. ARKANSAS WATER RESOURCES RESEARCH CENTER.
Arkansas Water Resources Research Center, Fayetteville.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87 112355/AS, Price codes: A03 in paper copy, A01 in microfiche. Institute Program Report G1004-01, June 1986. 30 p. Contract No. 14-08-0001-G1004, Project No. USGS G1004-01.

Descriptors: *Water Resources Institutes, *Research, *Information transfer, *Training, *Arkansas, *Education, Agricultural watersheds, Pollution effects, Soil water, Water treatment, Computer models, Soil salinity, Management, Simulation, Algae, Habitat, Reservoirs, Chemical analysis, Systems analysis.

Arkansas' major water problems are floods, droughts, water quality, groundwater mining, institutional arrangements, laws, financing, environmental concerns and public awareness. From this generalized list of problems, a more specific list was developed by the Technical Advisory Committee to provide goals and priorities for the principal investigators. Specific areas for research include three projects on agricultural water problems, one on surface water treatment and three technology transfer projects. The agricultural projects cover algal growth potentials and heavy metal concentrations from farm and forest lands, the behavior of soluble salt in a clay soil and the long-term effects of tillage on the retention and transport of soil water. The evaluation of packed towers for removing volatile organics from surface waters is a practical water treatment research effort. The technology transfer projects include water management simulator presentations, qualitative and quantitative aquatic algal data compilation for macrotrends and a local water resource management system. In these research and technology transfer projects, seventeen graduate and undergraduate students received training. (Mack-U. AR)
W87-06084

FISCAL YEAR 1985 PROGRAM REPORT. WISCONSIN WATER RESOURCES CENTER.
Wisconsin Univ.-Madison. Water Resources Center.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87 122099/AS, Price codes: A03 in paper copy, A01 in microfiche. Program Report G1053-02, August 1986. 41 p. Contract No. 14-08-0001-G1053, Project No. USGS G1053-02.

Descriptors: *Research, *Information transfer, *Training, *Wisconsin, Groundwater, Agricultural chemicals, Pesticides, Aquifers, Glacial aquifers, Model studies, Vadose water, Potable water, Utilities, Cost analysis, Economic aspects, Public policy, Risks.

The FY 1985 Wisconsin Water Resources Center program focused on the transport of contaminants to and through the groundwater system. Technical aspects of the program were augmented by projects that investigated the economic and institutional perspective on groundwater contamination and how these factors influence public and private decisions. From a management standpoint the program addressed questions of weather pattern effects and the effects of agricultural practices, such as crop rotations, time of application of pesticides and fertilizers and irrigation schedules, on contaminant movement. An understanding was gained of the effects of geotechnical properties on the movement of water in the vadose zones of glaciated areas. Characterizing adsorption/desorption kinetics enhanced the predictive capability of transport models by improving rate data for incorporation into the poorly understood reaction terms of the models. Maintenance and expansion of the Water Resources Reference Services collection and the retrieval and dissemination of water-related information have proved beneficial to university faculty, staff and students, state agency personnel, state legislators and other decisionmakers, private consultants, environmental groups, and the general public. (Sherman-U. WS)
W87-06086

FISCAL YEAR 1985 PROGRAM REPORT. ARIZONA WATER RESOURCES RESEARCH CENTER.
Arizona Water Resources Research Center, Tucson.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87 122057/AS, Price codes: A04 in paper copy, A01 in microfiche. Program Report G1003-01, August 1986. 49 p. Contract No. 14-08-0001-G1003, Project No. USGS G1003-01.

Descriptors: *Research, *Information transfer, *Training, *Arizona, Toxins, Microbial degradation, Organic compounds, Inorganic ion ratios,

Water origin, Irrigation management, water conservation, Irrigation technologies, Economics, Reference Crops, Evapotranspiration, Conjunctive management, Extreme flood events, Paleohydrology.

The research projects supported by the 85 Program addressed the following critical water issues in Arizona: water quality, water conservation, conjunctive management, and water management. Continuing Project 02 is examining the importance of biodegredation vs. either chemical transformation or sorption in decontamination aquifers containing chlorinated organics. The purpose of Project 09 is to determine the utility of using chloride/bromide ratios in water as an indicator of water origin. The objective of continuing Project 04 is to develop improved irrigation management criteria for the turf grass industry. The purpose of Project 05 is to undertake an economic assessment of alternative irrigation technologies for conserving water. Similarly, the objective of Project 06 is to examine the feasibility of using reference crops for evaluating evapotranspiration in Arizona. The goal of Project 07 was to examine the institutional and economic constraints on undertaking recharge and recapture schemes in southwestern alluvial basins using imported water. Project 08 focused on predicting extreme flood events using methods of paleohydrology. Information transfer comprised publishing news bulletins and information reports. (Authors' abstract)
W87-06087

FISCAL YEAR 1985 PROGRAM REPORT. PUERTO RICO WATER RESOURCES RESEARCH INSTITUTE.
Puerto Rico Univ., Mayaguez. Water Resources Research Inst.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87 122081/AS, Price codes: A02 in paper copy, A01 in microfiche. Program Report G1041-01, August 1986. 14 p. Contract No. 14-08-0001-G1041, Project USGS G1041-01.

Descriptors: *Research, *Information transfer, *Puerto Rico, Soil erosion, Sediment transport, Storm runoff, Controlled storage, Sludge disposal, Comprehensive planning, Sludge dewatering, Farm wastes, Pollutant identification.

The research activity at the Puerto Rico Water Resources Research Institute during FY 1985 included five research projects and one technology transfer activity. Two of the research projects, one on the establishment of a waste management system for a small dairy farm and another on the design of an island-wide sludge management plan for Puerto Rico, were carried out to completion. Still in progress are a study on the dewatering of sludge, the preparation of a model for the control of stormwater runoff, and a study on the erodibility characteristics of superficial soils in Puerto Rico. The technology transfer activity developed was a three-day congress on the water resources of the Caribbean Islands. (Munoz-Puerto Rico U, WRRI)
W87-06088

FISCAL YEAR 1985 PROGRAM REPORT. PENNSYLVANIA INSTITUTE FOR RESEARCH ON LAND AND WATER RESOURCES.
Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87 122065/AS, Price codes: A03 in paper copy, A01 in microfiche. Program Report G1040-01, August 1986, 21 p. Contract No. 14-08-0001-G1040, Project No. USGS G1040-01.

Descriptors: *Research, *Information transfer, *Training, *Pennsylvania, Acid rain, Streams, Water quality, Drought, Water treatment, Giardia, Groundwater, Water supply.

Three projects and a technology transfer effort were conducted during Fiscal Year 1985. The three projects addressed issues of concern to the Commonwealth, namely acid rain impacts, drought and drinking water problems. The technology transfer efforts also focused on drinking water quality and acid rain impacts. Complementing the Institute's ongoing program on acid precipitation and its effects, one study evaluated the feasibility of using in-stream remedial methods to combat stream acidification. Researchers demonstrated the feasibility of surface-groundwater blending to allow the development of a put-and-take fishery in a stream formerly acidified by atmospheric deposition. A second, continuing study is refining methods for drought flow management. Researchers are evaluating the sensitivity and reliability of drought indicators which trigger early response warnings in the event of drought so that water resources can be conserved. In the third study, researchers are developing an improved method for filtration of small water supply systems with a focus on Giardia removal. The specific objective is to investigate how well differnt grades of diatomaceous earth can remove Giardia muris from simulated surface waters under different hydraulic loadings. The Institute's 1985 technology transfer effort emphasized programs dealing with the management and water quality of private individual water supplies and with the environmental and potential health effects associated with acid precipitation. (McDonnell-Penn St U.)
W87-06089

FISCAL YEAR 1985 PROGRAM REPORT. TENNESSEE WATER RESOURCES RESEARCH CENTER.
Tennessee Water Resources Research Center, Knoxville.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87 122073/AS, Price codes: A03 in paper copy, A01 in microfiche. Program Report G1045-01, August 1986. 20 p., 1 fig.Contract No. 14-08-0001-G1045, Project No. USGS G1045-01.

Descriptors: *Research, *Information transfer, *Training, *Tennessee, Ground water, Monitoring design, Aquifiers, Water quality, Erosion control, Cropland, Cost analysis, Levees, Flood control, Flood profile.

This report details the FY 85 research program accomplished by the Tennessee Water Resources Center under the US Department of Interior's State Water Resources Research Institute Program. Foremost was the desire of the Tennessee Water Resources Research Center to direct its funded research efforts towards environmental and growth-related issues which have been identified by the Governor's Safe Growth Cabinet Council. This report provides an overview of three research projects/activities carried out during the FY 85 program period. Project 02 involved the design of a statewide ground water monitoring network which will assist the State of Tennesse in its efforts to establish an effective groundwater protection and management program. Project 03 focused on the important issue of soil erosion in West Tennessee. This project has contributed to the understanding of why traditional economic incentive strategies which are key components of federal and state erosion control programs have had limited success in controlling erosion in West Tennessee cropland. The project also evaluates how modified or new incentive strategies might increase the cost-effectiveness of state and federal programs designed to control soil erosion on these lands. Project 04 is the first phase of a two-year research project which will investigate the problems related to the construction of private levees in the floodplains of West Tennessee river systems. Phase I of the project has identified the nature and extent of the levee problems in West Tennessee and evaluated the hydraulic impacts of these levees on potential downstream and upstream flooding. (Gangaware-U. TN)
W87-06090

FISCAL YEAR 1985 PROGRAM REPORT. MARYLAND WATER RESOURCES RESEARCH CENTER.
Maryland Univ., College Park. Water Resources Research Center.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87 131710/AS, Price code: A03 in paper copy, A01 in microfiche. Program Report G1022-01, July 1986. 35 p. Contract No. 14-08-0001-G1022, Project No. USGS G1022-01.

Descriptors: *Water Research Institutes, *Research, *Information transfer, *Training, *Maryland, Drought, Irrigation, Water stress, Simulation analysis, Principal component analysis, Multivariate analysis, Acidity, Rain, Sulfates, Trace elements, Trace metals, Tidal marshes, Wetlands, Phytoplankton, Water pollution control, Invertebrates, Fish food organisms.

In response to the stated goals of the 1985 Maryland Water Resources Research Center, five projects were funded focusing on drought, acid precipitation, and the contamination of surface and ground waters with toxic chemicals and nutrients. Rainfall in Maryland is highly variable in its timing and is quite unpredictable from year to year. The effect of periodic drought on corn and soybean productivity has been the focus of a Center project. Various crop simulation models are being analyzed against field data from the 1985 and 1986 growing seasons. Acid precipitation is a matter of growing concern in Maryland. A project on the acidity of fog has revealed that fogs in Maryland are more acid than rains. Futhermore, the ratio of nitrate/sulfate is much greater in fog than rain. The biological effect of acid precipitation has been studied in assessing the impact of stream acidification on trout feeding behavior. It has been found that pH affects photoresponses of certain invertebrates, which in turn affects their availability as a food source for fish. Two projects have focused on water pollution problems. Of long-standing interest to the Center has been the problem of heavy metal accumulation in tidal marshes. These studies provide information on the geologic history of the Chesapeake Bay, the impact of human activities, and the effects on the biota. Results of the past year's studies indicate that tidal marshes are serving as a buffer between the metal-laden rivers and the Bay itself. In another study a practical method for harvesting algae blooms resulting from excess nutrients has been developed and is being tested. (Menzer-U. MD)
W87-06091

FISCAL YEAR 1985 PROGRAM REPORT. OKLAHOMA WATER RESOURCES RESEARCH INSTITUTE.
Oklahoma Water Resources Research Inst., Stillwater.
Available from the National Technical Information Service, Springfield, VA 22161 as PB87 112389/AS, Price codes: A04 in paper copy, A01 in microfiche. Program Report G-1038-01, August 1986. 43 p. Contract No.14-08-001-G-1038, Project No. USGS G1038-01.

Descriptors: *Water Resources Institutes, *Research, *Information transfer, *Training, *Oklahoma, Landfills, Groundwater, Groundwater pollution, Groundwater movement, Regulations, Permits, Model studies, Geophysics, Contamination, Hydrology, Adsorption, Trace metals, Geochemistry, Modeling, Water properties, Surfactants, Surface properties, Molecular structure, Mathematic models, Rill erosion, Sediment transport.

Hydrogeologic properties throughout the State of Oklahoma were studied to establish a reference of such properties to be used during site selection of landfills. Mapping of provinces of hydrologic properties are being created, in addition to maps of 25 mile zones of influence of all existing solid waste disposal sites and of population densities of 10/sq mile or greater. These maps are compared to aquifer distributions, and evaluations have been made as to potential landfill locations. Multifluid flow has been observed for a range of both immiscible and miscible components. Models for spilled hydrocarbons have been made, and a dielectric measuring technique has been incorporated into a flow cell to monitor fluid transport. The properties of metal ions, organic compounds, and solid phases when several metal ions, several solid phases and

naturally occurring soluble organics are all present simultaneously are being examined as potential sources of trace metal pollution. Simulation projects were performed on the hydrocarbon interior of bilayer or multilamellar vesicles and of the water/surfactant interface. The first has very important implications for understanding how hydrocarbon pollutants are partitioned into vesicular assemblies in surfactant solutions. The second is of value in understanding the structural nature of microemulsion solutions, and the interactions between aggregates in surfactant solutions. Energy dissipation rate terms were obtained for sediment-laden flows by deriving the mechanical energy equation of mean motion for two-phase flows. A rill erosion model was developed using minimum rate of energy dissipation. Results indicated that the energy dissipation rate is very sensitive to the change in Manning's n with suspended sediment load. (Redelfs-OKWRRI)
W87-06102

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